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July 15, 1962

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Volume 16, Number 13 July 15, 1962

NUCLEAR SCIENCE ABSTRACTS

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Chemistry
QC
770
.U56

TABLE OF CONTENTS

Volume 16, Number 13, July 15, 1962

Category *Page*

GENERAL AND MISCELLANEOUS . . 2071

BIOLOGY AND MEDICINE . . . 2085
- General and Miscellaneous . . . 2085
- Biochemistry, Nutrition, and Toxicology. 2096
- Fallout and Ecology 2097
- Radiation Effects on Living Tissues 2097
- Radiation Sickness 2116

CHEMISTRY 2119
- General and Miscellaneous . . . 2119
- Analytical Procedures 2119
- General Inorganic and Physical Chemistry 2122
- Radiation Chemistry and Radiochemistry 2131
- Raw Materials and Feed Materials 2137
- Separation Processes 2137

ENGINEERING AND EQUIPMENT . . 2140
- General and Miscellaneous . . . 2140
- Heat Transfer and Fluid Flow . . 2143
- Instrumentation 2145
- Materials Testing 2152

GEOLOGY, MINERALOGY, AND METEOROLOGY 2153

HEALTH AND SAFETY 2156

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS . . 2160

ISOTOPE SEPARATION 2161

MATHEMATICS AND COMPUTERS . . 2162

Category *Page*

METALS, CERAMICS, AND OTHER MATERIALS 2164
- General and Miscellaneous 2164
- Corrosion 2166
- Fabrication 2169
- Properties and Structure 2170
- Radiation Effects 2178

PHYSICS 2182
- General and Miscellaneous 2182
- Astrophysics and Cosmology. . . 2193
- Cosmic Radiation 2196
- Elementary Particles and Radiations 2197
- Neutron Physics 2209
- Nuclear Properties and Reactions 2209
- Particle Accelerators 2221
- Plasma Physics and Thermonuclear Processes 2223
- Shielding 2228
- Theoretical Physics 2229

REACTOR TECHNOLOGY 2230
- General and Miscellaneous 2230
- Power Reactors 2236
- Research Reactors 2239

SPACE APPLICATIONS AND TECHNOLOGY 2241

WASTE DISPOSAL AND PROCESSING 2244

CORPORATE AUTHOR INDEX . INDEX 1

PERSONAL AUTHOR INDEX . INDEX 8

SUBJECT INDEX . . . INDEX 32

REPORT NUMBER INDEX . INDEX 79

Volume 16, Number 13 July 15, 1962

NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

16029 (PNE-115P) TIMING AND FIRING. N. Hagopian (Edgerton, Germeshausen and Grier, Inc., Boston). Jan. 1962. Contract [AT(29-1)-1183]. 19p. Project GNOME

World Time as received on Gnome was officially recorded as 1200.00. 004 ± 1 msec, Mountain Standard Time. All monitors at the control point indicated that the performance of the timing system was completely satisfactory on the live run. Basic to the instrumentation for the event were the special mobile control point built for the Plowshare Program and a timing station housed in a transportainer and located in the area adjacent to surface zero. Both hardwire and radio signals, as requested, were transmitted to the experimenters. (auth)

16030 (TID-3710) INFORMAL LISTING OF BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. BIBLIOGRAPHIES ISSUED OR IN PROGRESS DURING THE PERIOD, FEBRUARY–MARCH 1962. (Division of Technical Information Extension, AEC). 26p.

A listing of 158 bibliographies of atomic energy literature is presented. The references are arranged alphabetically by title under corporate author headings. Subject, author and report number indexes are included. (M.C.G.)

16031 (TID-14314) EMPLOYMENT OPPORTUNITIES IN THE ATOMIC ENERGY FIELD. (Bureau of Labor Statistics). [1961]. 53p.

Descriptions and employment outlook information about the major scientific, engineering, technical, and skilled occupations found in the atomic energy field are presented. Educational and training requirements and opportunities are listed. A bibliography, suggestions on how to find employment, and the names and addresses of typical establishments employing atomic energy workers are included. (M.C.G.)

16032 (JPRS-13480) NUCLEAR EXPLOSION OVER THE TAIGA (STUDY OF THE TUNGUSKA METEORITE). F. Yu. Zigel. Translated from Znanie-Sila, No. 12, 24-7(Dec. 1961). 11p.

Results of an expedition in the region where the Tunguska Marvel fell on June 30, 1908 are presented. It was found that after 1908 the radioactivity, as found in trees, increased sharply; this change was thought to be associated with the Tunguska explosion. A similar increase occurred after 1945. (J.R.D.)

16033 (UCRL-Trans-806(L)) CINEMATOGRAPHY OF THE STUDY OF UNDERGROUND EXPLOSIONS. L. K. Belopukhov. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Zhur. Priklad. Mekhan. i. Tekh. Fiz., No. 4, 51-4(1960). 8p.

The use of cinematographic methods for study of the phenomena associated with underground explosions is reported. The essential facts derived from an investigation of ground motion kinematic characteristics in initial excavation stages are discussed for a wide range of soils and explosive strengths. (J.R.D.)

16034 ECONOMIC ASPECTS OF THE PRODUCTION OF ELECTRONUCLEAR ENERGY. Energia elettrica, 37: 1214-19(Dec. 1960). (In Italian)

Cost evaluations for the production of electronuclear energy are made and compared with the costs of carbon-fueled power plants and the costs of grid-produced power. The data on which the calculations are made are American, German, and Swiss. The criteria adopted for the calculations are reviewed first. (J.S.R.)

16035 DOORWAY TO LEGAL NEWS, VOL. 6, NO. 2, 1961. (Division of Technical Information, AEC). 239p.

Legislative, regulatory, and legal literature on nuclear science and related subjects are reviewed. Abstracts are presented of current books; monographs; reports of government agencies, educational, industrial, and research organizations; U. S. Congressional studies; federal, state, and foreign legislation; and selected translations and legal articles. (M.C.G.)

16036 GÉNIE ATOMIQUE. TOME QUATRE. LES MATÉRIAUX NUCLÉAIRES. VOLUMES UN ET DEUX. (Atomic Engineering. Tome IV. Nuclear Materials. Volumes 1 and 2). Saclay, France, Institut National des Sciences et Techniques Nucléaires and Paris, Presses Universitaires de France, 1961. 1848p.

A review is given of the extraction, physical properties, mechanical properties, physical metallurgy, and relations to properties of solids in general of U, Pu, and Th metals. Nuclear structural materials are reviewed, including Al, Mg, Be, Zr, alloys of these metals, and steels. Refractory materials are surveyed, including UO_2, uranium carbides, and BeO. The production and properties of graphite are outlined. An investigation is made of fuel elements for heterogeneous reactors and of control elements. Radiation effects on nuclear materials are surveyed, with particular attention to fast neutron effects on graphite, physical-chemical behavior of light and heavy water in reactors, interactions between graphite and cooling liquids, and organic liquid coolant behavior. Corrosion problems in water-, gas–, and liquid-metal-cooled reactors are reviewed. Isotope separation techniques are summarized, emphasizing isotopic exchange reactions, electromagnetic separation, U-isotope separation, and heavy water production. Processing procedures for irradiated fuels are detailed. The preparation and industrial and medical uses of artificial radionuclides are reviewed. Methods for measuring radioactivity are examined. (T.F.H.)

16037 RADIOISOTOPES IN THE PHYSICAL SCIENCES AND INDUSTRY. VOL. I. Proceedings of the Conference on the Use of Radioisotopes in the Physical Sciences and Industry held at Copenhagen, 6-17 September 1960. (International Atomic Energy Agency, Vienna). Proceedings Series. Jan. 1962. 549p. (STI/PUB/20(Vol.I)). $8.00 (IAEA).

Forty-seven papers are included; separate abstracts have been prepared for 38. Of the papers abstracted separately, 26 are in English, 5 in French, and 7 in Russian. Nine papers were previously abstracted in NSA. (T.F.H.)

16038 METEORITES AS SPACE PROBES FOR COSMIC RAYS. O. A. Schaeffer, R. W. Stoenner, and R. Davis, Jr. (Brookhaven National Lab., Upton, N. Y.). p.3-11 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (BNL-4782) (In English)

An experiment is performed to test the spatial constancy of high-energy cosmic radiation within the solar system by measuring a short-lived and a long-lived cosmic-ray induced radioactivity in a recently fallen meteorite. This test depends on the fact that meteorites have highly eccentric orbits and therefore serve as space probes over the region between the earth's orbit and the asteroidal belt. The short-lived activity is produced while the meteorite is in the vicinity of the earth's orbit, while the long-lived activity is produced over the entire orbit of the meteorite. The 35-day argon-37 and the 325-year argon-39 activities are observed in a meteorite. The relative activities are compared with the production rates of the isotopes derived from bombarding a sample of the meteorite with 3-Bev protons. It is concluded that the cosmic-ray flux is the same in the asteroidal belt as it is near the earth's orbit. (auth)

16039 THE RADIATION AGE OF METEORITES. K. Goebel and P. Schmidlin (European Organization for Nuclear Research, Geneva). p.13-27 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Radioisotopes produced by cosmic radiation in meteorites while traveling through space can be used to trace the history of these meteorites. The radioisotopes and the accumulated daughter-elements in the meteorite must be determined in order to evaluate how long the meteorite was exposed to cosmic radiation.Tritium and argon are primarily used. From the ratio H^3/He^3, radiation ages from a few millions to several hundred millions of years are found. The probable errors from diffusion-losses of gas and the influence of shielding in the pre-atmospheric meteorite are discussed in the paper. By taking into consideration the measured cross section for tritium production in the elements that form the meteorite, the values of the cosmic-ray flux in outer space can be determined. (auth)

16040 Os^{187}-ISOTOPE ABUNDANCES IN TERRESTRIAL AND METEORITIC OSMIUM AND AN ATTEMPT TO DETERMINE Re/Os-AGES OF IRON METEORITES. W. Herr (Max-Planck-Institut für Chemie, Mainz and Kernforschungsanlagen, Jülich, Ger.), W. Hoffmeister, J. Langhoff, J. Geiss, B. Hirt, and F. G. Houtermans. p.29-36 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The isotopic composition of a number of Os samples from terrestrial platinum ores and from iron meteorites is investigated by mass spectrometry. The observed isotope-ratios Os^{187}/Os^{186} in Os/Ir ores and in Os samples, extracted quantitatively from iron meteorites, vary in limit from 0.88 to 1.41. These variations may be explained by the production of radiogenic Os following the decay of Re^{187}, a natural β-emitter. Neutron activation analysis proves that Re and Os are common trace elements in iron meteorites. A primordial Os^{187}/Os^{186} ratio is assumed, and "minimum ages" are discussed. They differ widely and are found in the range from 3.7 to 5.6×10^9 yr. (auth)

16041 DIRECT MEASUREMENT OF THE HALF-LIFE OF Rb^{87}. A. McNair and H. W. Wilson (United Kingdom Atomic Energy Authority, Aldermaston, Berks, Eng.). p.37-44 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The half life of Rb^{87} is measured directly, by determining the specific activity by a counting method. Direct counting is difficult because of the presence of a large number of very-low-energy electrons in the Rb^{87} spectrum. To increase the accuracy of the measurements, the following method is used: the source thickness is reduced by use of a 4π proportional counter of large source area (up to 100 cm^2), anti-coincidence operation to reduce background, and enriched Rb^{87}, which permits a four-fold reduction in source thickness for a given activity. By this method, sources down to 5 $\mu g/cm^2$ are measured. The relationship between half-life and source thickness is examined so that correction can be made for the very small absorption that remains. The effect of source backing thickness is not so great and can be calculated from the difference in count-rates on either side of the thin supports used and a study of dependence of half life on source support thickness. These experiments give a value of about 5.25×10^{10} years for the half life. (auth)

16042 AIR RADIOACTIVITY IN THE ANTARCTIC IN 1958 AND RADIOACTIVE PROFILE BETWEEN 60°N AND 70°S. E. Picciotto, S. Wilgain, P. Kipfer, and R. Boulenger (Université Libre, Brussels and Centre d'Études Nucléaires, Mol, Belg.). p.45-56 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In French)

Measurements of Antarctic atmospheric radioactivity during the International Geophysical Year (1958) are described. The measurements are related to the concentration of fission products and natural radioelements (radon, thoron, radium D) in the air and in precipitations, and to the intensity of radioactive fall-out. A description is also given of the distribution of fission products along the 24th meridian East, between 60° North and 70° South. It is shown that fission products are present in the Antarctic atmosphere and precipitations. Their average concentration corresponds to an activity of 0.12 dpm/m^3, i.e., about 2% of the concentration in the Northern hemisphere. The Po concentration in the air is 10^{-16} $curie/m^3$. These radionuclides can be used for dating the formation of the different layers of névé and ice during recent decades and for measuring the rates of accumulation on the continent. The distribution of fission products along a meridian and a knowledge of their average age yield data on the meridional exchange of air masses. (auth)

16043 USE OF NUCLEAR PHYSICAL METHODS IN PROSPECTING AND WORKING OIL AND GAS DEPOSITS. G. N. Flerov. p.117-22 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In Russian)

Nuclear physical methods used for the prospecting, exploration, and working of mineral resources are reviewed. (auth)

16044 APPLICATION OF NUCLEAR PHYSICS METHODS TO POTASSIUM-SALTS PROSPECTING. J. Czubek (Academy of Mining and Metallurgy, Krakow), B. Dziunikowski, J. Krzuk, J. Niewodniczanski, K. Przewlocki, A. Zuber, J. Jurkiewicz, and Z. Werner. p.123-34 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Radiation logging is a useful method for identification of the main types of salt rocks in mines. Quantitative interpretation of gamma log data allows the potassium content to be estimated directly in the bore-hole. Comparison of the quantitative analysis for potassium by a chemical method and by a gamma-ray logging method shows that the latter gives satisfactory results. It should be taken into account that chemical analysis of bore-core material concerns only the actual volume of the sample, while the radiation method gives information on the average potassium concentration of volumes about 10 times greater. Radiation logging proves to be useful not only for differentiation between sylvites and carnallites, but also enables some of the non-radioactive-salt minerals, such as kieserite or anhydrite, to be detected. It is possible by means of this method to estimate the content of the latter in potassium-salt rocks. Differentiation of clay salts from poor carnallites is also possible. Thus, a full geological profile of a given bore-hole may be obtained by applying the various radiation logging methods. Any doubts about the interpretation may be eliminated by the quantitative analysis of the neutron-gamma and gamma-gamma logs. (auth)

16045 DIFFUSION RATES IN THE REGION CLOSE TO THE FREE SURFACE OF A METAL. L. W. Barr, D. A. Blackburn, and A. F. Brown (Univ. of Edinburgh). p.137-44 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Chemical sectioning methods are developed by which sections down to 1 μm thick can be removed from the surface of copper single crystals. By these means diffusion coefficients are obtained using diffusion depths of only 10 to 15 μm. The accuracy is comparable with that achieved by mechanical sectioning methods using diffusion depths of the order of 1 mm. Using these techniques, the diffusion-temperature curve for antimony in copper is extended down to 540°C. A comparison of the results with those obtained by mechanical sectioning shows that the diffusion coefficient obtained from the small diffusion depths at the lower temperatures is significantly lower than that obtained using conventional diffusion depths. Hence it is suggested that the region of a metal near a free surface is deficient in vacancies. (auth)

16046 DIFFUSION IN MOVING GRAIN-BOUNDARIES. D. A. Blackburn and A. F. Brown (Univ. of Edinburgh). p.145-57 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Bicrystals of copper are sheared along the common boundary at rates of 0.06 to 0.3 μm/h at temperatures around 725°C. Penetration of Ag^{110} into static boundaries and boundaries moving in this way is studied by autoradiography. For both moving and static boundaries agreement is obtained with Fisher's formula. The ratio of the diffusivities in the grain boundary and the bulk crystal (D'/D) is about 10^6. For the boundaries studied D'/D appears to increase slightly with total shear and with shear rate, but only by a factor of not more than two over the ranges investigated. (auth)

16047 MASS DEPENDENCE OF INTERMETALLIC DIFFUSION. D. Lazarus (Univ. of Illinois, Urbana). p.159-68 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Studies have been undertaken to determine specific effects of isotopic mass on the rates of intermetallic diffusion, in order to test the application of absolute-reaction-rate theory to the diffusion process and to predictions regarding correlation between tracer and solvent atom jumps. Precision sectioning techniques are employed, using Fe^{55} and Fe^{59} tracers in pure silver and copper monocrystalline specimens. In order to measure the small mass dependence, extreme precision is required. Since the two iron isotopes have completely different decay schemes, accurate differential counting can be performed using beryllium and gold absorbers, after a radiochemical separation of the tracers from the host material. Results indicate that the relative rate of diffusion of the two isotopes is considerably less than that expected classically, implying either a departure from equilibrium during the elementary diffusion jump or a strong correlation between solute and solvent atom jumps. The temperature dependence of the effect is also discussed. (auth)

16048 MEASUREMENT OF COEFFICIENTS OF CATION SELF-DIFFUSION IN SILICATE MELTS BY MEANS OF THE RADIOISOTOPES Na^{24}, K^{42} AND Ca^{45}. V. I. Malkin and B. M. Mogutnov. p.169-78 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In Russian)

For a better understanding of the factors determining the effect of the interaction between cations on their mobility, it is of interest to determine the absolute value of the cation mobility in various silicate melts having identical silica concentrations and containing sodium ions in combination with other cations. For this purpose the self-diffusion coefficients of the ions Na^+, K^+, and Ca^{++} are measured in the melts $Na_2O \cdot 2SiO_2$, $Na_2O \cdot K_2O \cdot 4SiO_2$, $Na_2O \cdot Li_2O \cdot 4SiO_2$, and $Na_2O \cdot CaO \cdot 4SiO_2$ by means of the radioisotopes Na^{24}, K^{42}, and Ca^{45}. The self-diffusion coefficient of the Na^+ ion in these melts decreases in the order $Na_2O \cdot 2SiO_2$; $Na_2O \cdot Li_2O \cdot 4SiO_2$; $Na_2O \cdot K_2O \cdot 4SiO_2$; and $Na_2O \cdot CaO \cdot 4SiO_2$. Measurements of the self-diffusion coefficients of the K^+ and Ca^{++} ions in the melts $Na_2O \cdot K_2O \cdot 4SiO_2$ and $Na_2O \cdot CaO \cdot 4SiO_2$ show that the ratio of the cation self-diffusion coefficients in these melts corresponds to that of their tranport numbers. The results show that when the two cations are combined in various ways in the silicate melts, their mobility can be determined from the degree of structure condensation and also from the joint polarization of the anions by the two cations. (auth)

16049 SELF-DIFFUSION IN VOLUME AND AT THE GRAIN-BOUNDARIES OF GAMMA-IRON OF HIGH PURITY (99.99%). P. Lacombe, P. Guiraldenq, and C. Leymonie (École Nationale Supérieure des Mines, Paris). p.179-92 of "Radioisotopes in The Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In French)

In the case of a semi-infinite solid, the post-diffusion concentration $C(x_n)$ of radioactive atoms at distance x_n from the initial radioactive deposit is a simple function of the over-all activity remaining in the sample after abrasion to depth x_n. By measuring the remaining over-all activity as a function of the depth of penetration, the part of the activity due to self-diffusion in volume is shown to be distinguishable from that due to intergranular self-diffusion. The advantage of this method is, therefore, that it enables a continuous measurement on a given sample of the passage from self-diffusion in volume to intergranular self-diffusion. This method is used for measuring the self-diffusion constants in gamma iron in volume between 1260 and 918°C and at grain boundaries between 1020 and 918°C. (auth)

16050 DIFFUSION, RECRYSTALLIZATION AND PHASE TRANSFORMATIONS. S. Z. Bokshtein, M. A. Gubareva, S. T. Kishkin, and L. M. Moroz. p.193-206 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In Russian)

A method is developed for studying with radioisotopes the behavior of grain boundaries in the process of plastic deformation and subsequent recrystallization. It is shown that iron recrystallization at relatively low (15%) and high (50 to 70%) degrees of deformation does not lead to any essential change in the location of the basic metal atoms situated at the boundary of the initial grains. If the metal structure changes considerably after recrystallization and also after the polymorphous $\alpha \rightleftharpoons \gamma$ transformation, the boundary atoms of the initial grains are only slightly displaced. In the same way, impurity atoms (radioactive carbon) situated at the boundaries of the initial grain do not migrate across the boundaries of the new grains of recrystallized metal. Plastic deformation, however, is accompanied by considerable migration of the atoms situated at the grain boundary. The data show that the migration of grain boundaries during recrystallization and subsequent grain-growth are associated with some specific mechanism differing from ordinary diffusion. It is shown that structural changes occurring in alloys at high temperatures can change the rate of self-diffusion and hetero-diffusion processes. A study of the diffusion processes in titanium and its alloys in connection with the polymorphous state shows that the rate of the process in different titanium-crystal variations varies greatly. This result eliminates any discrepancy between the high melting-point of titanium and the relatively low activation energy of the diffusion process in titanium. (auth)

16051 USE OF RADIOISOTOPES IN STUDYING THE PENETRATION OF SULPHUR INTO IRON DURING HYDROGEN CATHODE CHARGING. S. Besnard and J. Talbot (Centre National de la Recherche Scientifique, Vitry, France). p.207-16 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In French)

Certain elements, arsenic for example, are used to facilitate the penetration of hydrogen into iron. It is found in industry that steel corrosion caused by hydrogen is aggravated by the presence of sulphurated hydrogen. A study of this phenomenon is made, using electrolytic pure iron. Hydrogen supersaturation is effected by cathode charging. The addition element is S^{35}-labelled sodium sulfide. It is shown that in half an hour at −15°C, the sulfur penetrates into the iron to a depth of some 120 μm. A perferential localization of the sulfur at the grain boundaries is also noted. (auth)

16052 STUDY OF INCLUSIONS AND SEGREGATION IN METALS BY AUTORADIOGRAPHY. S. M. Makin (Wantage Research Lab., Berks, Eng.). p.217-23 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Applications of radioisotope techniques to metallurgy are described. Autoradiographic techniques are developed, including the irradiation and autoradiography of extraction replicas, similar to those used in electron microscopy, and a two-color dye-transfer process in which color prints of autoradiographs are shown with the corresponding micrographs superposed. These methods are applied to the study of inclusions in steel and uranium and to an investigation of the segregation of sulphur and phosphorus in welds in stainless steel. (auth)

16053 THE DETERMINATION OF THE THERMODYNAMIC ACTIVITY OF ANTIMONY IN ALPHA-IRON. I. A. Tomilin. p.225-33 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In Russian)

A method is suggested for determining the thermodynamic activity of antimony dissolved in alpha-iron, based on the study of antimony distribution between the liquid lead and solid iron. By this method, it is found that solid solutions of antimony in alpha-iron can be distinguished by positive divergences from the ideal state. Over a fairly wide range of concentrations, solutions of antimony in iron obey Henry's law. Special experiments on the distribution of antimony between lead and liquid iron showed that in the liquid state also the iron-antimony system is marked by positive divergences from the ideal state when small concentrations of antimony are present. The heat required for the solution of antimony in alpha-iron, and the excess partial molar entropy, are calculated from the activity temperature. The results are used for accurately locating the line showing the solubility limit of antimony in alpha-iron. Since alloys of antimony with iron are obtained by diffusion saturation and not by cooling from the liquid state, there is no liquefaction. Thus the lattice constant of the alloys and its relation to the alloy concentration could be reliably determined. The solubility limit established from x-ray data agrees with that obtained with Sb^{124}. (auth)

16054 STUDY OF REACTIONS OF METALS WITH SULPHUR AND PHOSPHORUS COMPOUNDS BY PULSED TEMPERATURES. R. B. Campbell and L. Grunberg (National Engineering Lab., East Kilbride, Glasgow). p.235-49 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The anti-wear action of sulfur and phosphorus compounds added to gear-oils depends on chemical reactions with the metallic surfaces of the gears. These reactions occur both at the bulk oil temperature (approx. 100°C) and during high temperatures (approx. 600°C) of short duration when the gear-teeth come into contact under load. The temperature flashes are simulated in an apparatus in which short pulses of electric current are used to heat metal wires immersed in mineral oil containing S^{35} and P^{32} labeled compounds in solution. The radioactivity acquired by the wires is measured. The extent of the reactions is determined as a function of temperature and time and the results interpreted in terms of kinetic laws. The modification of the reaction rates by the presence of other compounds in the solution is studied. The effect of pre-formed surface films containing sulfur, phosphorus, chlorine, and/or oxygen is also determined. In explaining the results, the structure of the materials used and the diffusion processes wherby the reactions occur beyond the initial stoages are considered. (auth)

16055 THE USE OF RADIOACTIVE INSERTS IN THE STUDY OF METAL DEFORMATION DURING TUBE-MAKING PROCESSES. W. H. T. Davison (Tube Investments Research Labs., Cambridge, Eng.). p.251-60 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The use of radioactive inserts in studying the deformation of steel in hot rotary piercing for tube making is described. Iron or steel wires are activated and inserted in tubes drilled in iron or steel billets, which are then processed under normal production conditions. On cooling, the billets are scanned using a collimated scintillation counter mounted normal to the surface of the pierced billet, and isodose curves show the shape of the deformed insert normal to the tube surface. A similar scan of a section normal to the axis of the tube gives a second plot; from a combination of the two plots, a three-dimensional picture is obtained. The insert must be located within a millimeter or thereabouts, for which a high resolution is required. The problems of achieving this resolution are discussed in terms of γ-energy, collimator design, and energy discrimination. (auth)

16056 TRANSMUTATION DOPING AND RECOIL EFFECTS IN SEMICONDUCTORS EXPOSED TO THERMAL NEUTRONS. J. H. Crawford, Jr. and J. W. Cleland (Oak Ridge National Lab., Tenn.). p.269-86 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Studies of thermal neutron exposure of germanium are made. Of the five isotopes, three transmute to chemical impurity whose yields in atoms per 100 neutron captures and half lives are: Ga^{71}, 30.4, 11.4 days; As^{75}, 9.8, 82 min; Se^{77}, 1.2, 39 hr. Therefore, ~3 acceptors (Ga^{71}) are introduced for each donor (As^{75} and Se^{77}) and through choice of exposure one may decrease the electron concentration of n-type Ge to very low values or convert n-type Ge to p-type. The half life leading to Ga^{71} is conveniently long that details of the "radioactive titration" may be followed by Hall coefficient and conductivity. Experiments also show that approximately one electron per neutron capture is removed by lattice defects created by the recoil of nuclei from capture γ-ray emission. These displaced atoms may be restored to normal lattice sites by annealing at ~450°C. Recoil effects in silicon are also observed, approximately two charge carriers being removed per capture. Implications of the results are discussed in terms of the capture γ-ray spectrum. In indium antimonide the capture γ-rays from In^{115} are not sufficient to displace a large number of nuclei and the major effect is production of Sn^{116}, a donor when substituted in an indium lattice position. (auth)

16057 STUDY OF THE DIFFUSION AND SOLUBILITY OF VARIOUS INGREDIENTS IN GERMANIUM. E. G. Miselyuk, V. E. Kosenko, L. A. Khomenko, and V. D. Ignatkov. p.287-94 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In Russian)

The diffusion process and solubility of elements in germanium were studied with the radioisotopes Ag^{110}, Fe^{59}, Cd^{115}, Te^{127}, and Ta^{182}. Studies were carried out with scintillation counters on monocrystalline germanium of high purity with a residual ingredient concentration of $\leq 5 \times 10^{12}$ cm^{-3} at temperatures from 700 to 930°C. The volume diffusion coefficients for Ag, Fe, Cd, and Ta were found to be respectively (at 800°C) 8×10^{7}, 1.6×10^{-6}, 4.2×10^{-12}, and 6.5×10^{-13} cm^2/sec. From the solubility temperatures their maximum concentrations were fixed at $C_{Ag} = 1.1 \times 10^{15}$ cm^{-3}, $C_{Fe} = 1.5 \times 10^{15}$ cm^{-3}, $C_{Cd} = 4 \times 10^{18}$ cm^{-3}, and $C_{Ta} = 2 \times 10^{18}$ cm^{-3}. The coefficient of surface diffusion for Ag proved to be higher than the volume diffusion coefficient by one order of magnitude at 850°C and six orders of magnitude at 200°C. An intense evaporation of germanium, 2 orders of magnitude higher than in a vacuum, was observed in tellurium fumes. (auth)

16058 APPLICATION OF RADIOISOTOPES TO STUDIES OF CRYSTAL IMPERFECTIONS. R. L. Sproull, G. A. Slack, M. Moss, R. O. Pohl, and J. A. Krumhansl (Cornell Univ., Ithaca, N. Y.). p.295-9 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Radioisotopes are used in two ways in studying imperfections in alkali halide crystals. The zone refining of the compounds is monitored by addition of tracers, and segregation coefficients are determined from such measurements. The other application lies in the insertion of small concentrations of impurity ions into alkali halides in order to study the phonon scattering by such impurities or by the vacancies they introduce; these measurements are carried out at very low temperatures, where the phonon mean free path is limited by lattice imperfections. (auth)

16059 THE USE OF OXYGEN-14 IN THE STUDY OF POSITRON POLARIZATION IN A FERMI-TYPE TRANSITION. F. H. Schmidt, J. B. Gerhart, J. C. Hopkins, H. Bichsel, and J. Stroth (Univ. of Washington, Seattle). p.303-12 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The short-lived radioisotope O^{14} is used in two experiments designed to determine the degree of polarization of the decay positrons. In the two-component theory of beta-decay, the non-conservation of parity implies that positrons have their spin angular momentum polarized in the direction of motion by an amount proportional to their velocity divided by the velocity of light. The proportionality constant depends upon the type of interaction responsible for the decay process. The properties of 72-sec O^{14} are suitable for a test of certain aspects of the theory. O^{14} decays from a zero-spin, even-parity state to another zero-spin, even-parity excited state in N^{14}. Therefore, the decay is a pure Fermi-type. The O^{14} is produced by a $N^{14}(p,n)O^{14}$ reaction by a continuous N_2 flow system. O_2 carrier gas is added to the N_2. After activation the gas passes through suitable filters to remove unwanted activities, and to combine the oxygen with hydrogen. The active water vapor is trapped at liquid N_2 temperature on a copper rod to form a strong (~10 mc) continuous source of O^{14}. Decay positrons are energy-analyzed in a magnetic spectrometer. The longitudinal polarization of the positrons emerging from the spectrometer is studied by two methods. In the first the positrons impinge upon a plastic scintillator where some of them annihilate in flight. The more energetic annihilation quantum is circularly polarized in the same sense as that of the original positron. These gamma rays are Compton-scattered from magnetized iron and detected in a NaI(Tl) scintillation counter. An asymmetry in the scattering cross section with the direction of magnetization is related to the original amount of positron polarization. In the second method the positrons are focussed upon a magnetized iron foil. The positron-electron, or Bhabha, scattering cross section depends upon the sense of magnetization of the iron foil relative to the positron polarization. The scattered electron and positron are detected in plastic scintillation counters operating in fast coincidence. For both methods the asymmetries are small, and long counting-periods are required. The results show that 1-Mev O^{14} positrons are right-hand polarized. The annihilation method gives the value (0.73 ± 0.17) v/c, and the Bhabha scattering method gives (0.97 ± 0.19) v/c. The simplest theory predicts 1.00 v/c. It is believed that the Bhabha scattering method is the more reliable, chiefly because the relation between asymmetry and polarization is easier to calculate. (auth)

16060 RESONANCE ABSORPTION OF NUCLEAR GAMMA RADIATION. S. S. Hanna and G. J. Perlow (Argonne National Lab., Ill.). p.313-27 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Recoilless emission and absorption of nuclear radiation provide a means of studying the interaction of nuclei with electromagnetic radiation and provide a sensitive tool for the investigation of a large number of physical problems. A favorable situation arises with the Fe^{57} nucleus where resonance absorption may be used as a sensitive detector of the frequency change of electromagnetic radiation. Resonance absorption in Fe^{57} is studied. The strength of the absorption, the line shape, and line shift are observed as functions of temperature. The polarization of the radiation is examined by means of experiments with magnetized sources and absorbers. The hyperfine spectrum of the resonance radiation is analyzed with and without polarization. These studies lead to an interpretation of the hyperfine structure in terms of the properties of the nuclear states and the hyperfine interaction in iron. The effect of an external magnetic field on the hyperfine structure is also investigated. The resonance absorption in Fe^{57} is used to study the connection between the time development of the decay of a nuclear state and the spectrum of the observed radiation. Observations are made of the time spectrum of filtered resonance radiation for a variety of conditions. (auth)

16061 NUCLEAR ORIENTATION EXPERIMENTS WITH U^{233}, U^{234}, U^{235} AND Np^{237} ISOTOPES. L. D. Roberts, J. W. T. Dabbs, F. J. Walter, S. H. Hanauer, and G. W. Parker (Oak Ridge National Lab., Tenn.). p.329-40 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Low-temperature nuclear orientation studies are made with uranyl and neptunyl ions on the nature of alpha-particle emission and neutron fission, relative to oriented-nuclear-spin systems. These experiments demonstrate that the predominant alpha emission is perpendicular to the c-axis as the nuclei become oriented, which implies an unusual bonding configuration for the uranyl ion. Studies are also made of the angular distribution of fission fragments from the thermal neutron fission of oriented U^{233} and U^{235} nuclei. It is found that the fragment emission from U^{233} is isotropic and independent of nuclear orientation. For U^{235} the predominant fragment emission is along the crystalline c-axis when the nuclei are oriented. (auth)

16062 THE USE OF RADIOTRACER TECHNIQUES TO STUDY LUBRICATION AND WEAR IN LARGE DIESEL ENGINES. J. E. Howes, Jr., W. J. Braun, and D. N. Sunderman (Battelle Memorial Inst., Columbus, Ohio). p.343-53 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Radiotracer techniques are applied to the study of lubrication and wear in large diesel engines. Both lubricating-oil consumption and cylinder-liner wear are evaluated as a function of operating conditions on diesel engines in the 1000 hr range. Techniques are developed for tapping 200 gal (US) of lubricating oil with 60 mc of zinc-65 and determining oil consumption by sampling exhaust gas during operation under a variety of conditions. Measurement of the rate of lube-oil consumption can be made in 10 min. Irradiation techniques are developed for neutron activation of the lower cylinder portion of a 48-in. long, 8-in dia. cylinder liner. Suitable thermal-neutron shielding allows production of 300-d manganese-54, which results in extending the useful life of the liner for wear studies by a factor of six to eight over that of a comparable liner thermally activated to produce iron-59. Studies with very large quantities of radioactive material can be carried out in standard research facilities in the diesel engine field. Selective activation and judicious use of thermal-neutron shielding increases the versatility of the tracer technique in localizing measurement to areas of interest, reducing the total quantity of radioactive material required in wear studies of large parts, and facilitating simultaneous wear-measurement on engine parts of identical chemical composition. (auth)

16063 THE USE OF RADIOACTIVE TRACERS IN LUBRICATION AND WEAR RESEARCH. R. B. Campbell, L. Grunberg, A. A. Milne, and K. H. R. Wright (National Engineering Lab., Thorntonhall, Glasgow). p.355-68 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

In many lubrication and wear problems, processes occurring on a very small scale must be studied and the great sensitivity of radioactive tracer methods is applied. Several examples of such applications are cited. The quantitative relation between metal transfer and boundary friction is studied as a function of sliding velocity, surface roughness, and the presence of lubricants. In order to study the distribution of wear, cast iron plugs containing Ir^{192} are inserted in the liners of a diesel engine and the radioactivity present in oil samples is measured. Radioactive iron and iron oxide particles are used to study their role in the wear process. The reactivity of strained metal surface is studied with the aid of C^{14}-labeled stearic acid and of S^{35} in solution. The reaction rates of gear oil additive are studied by passing short electric-current pulses through metal wires immersed in solutions of compounds labeled with S^{35} and P^{32}. The build-up of anti-wear films on the surface of gear teeth is studied as a function of lead, speed, and running time. (auth)

16064 METHODS OF INVESTIGATING THE OPERATIVE PROPERTIES OF LUBRICATING OILS WITH RADIOACTIVE TRACERS. Yu. S. Zaslavskii and G. I. Shor. p.369-80 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In Russian)

A tracer method was devised for investigating electrokinetic processes and sedimentation in oils with additives containing labeled carbon black. The method employs beta-counters acting both as radiation detectors and electrodes; these create an electric field, so that the displacement rate of the labeled carbon black in oils containing additives, under the influence of the electric and gravitational fields, can be recorded automatically. The method is suitable for investigating different dispersion systems with a labeled dispersal phase. The essential difference between the requirements for the chemical compounds respectively constituting anti-corrosive and anti-friction additives are defined precisely. This difference is the basis of a complex method of investigating multi-component additives having a high anti-friction efficiency but no corrosive action. The method employs radiometric determination of the corrosive effect of oils containing anti-friction additives during interaction with radioactive copper, selection of the most corrosive anti-friction components, choice of effective anti-corrosive components to go with these, and determination with the 4-ball apparatus of the anti-friction efficiency of the mixture so chosen. Measurement of the absorption and scattering of the beta radiation from different radioisotopes in sedimentary layers of varnish and scale is described. Methods are devised for investigating the cleansing properties of motor oils containing additives when used in laboratory equipment and propulsion units. Investigation with radioactive tracers of the neutralizing properties of additives mixed with motor oil is used for determining the elimination of these properties when different constituents of additives are mixed in. The results of laboratory investigations are compared with the data from engine tests. (auth)

16065 RADIOISOTOPIC CONTROL OF WEAR ON THE SUSPENSION BEARING OF LARGE TURBOGENERATORS. Z. Frynta, F. Khol (Kkhol), and V. Kopecký (Kopetskii) (State Scientific Research Inst. of Materials and Tech., Prague). p.381-5 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In Russian)

A method of measuring wear on the suspension bearings of turbo-assemblies was evolved. A few small areas on the contact surface of the bearing were activated and the loss in activity measured by a Geiger-Mueller counter, mounted 20 mm from the activated bearing. This method was used to study the kinetics of wear on the bearing used in a turbogenerator set over a period of 3600 hr from startup. It was found that the main wear occurs during the first 400 hr, when seizure of the bearing presents the greatest danger. Radioactive silver was used to activate the bearing. By this means it was possible to register wear of the order of 1 to 2 μm. (auth)

16066 USE OF RADIOACTIVE SOURCES FOR STUDYING WEAR OF REFRACTORY LININGS. G. Courtois (Commissariat à l'Énergie Atomique, Saclay, France), R. Hours, P. Le Clerc, and A. Pons. p.405-14 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In French)

Success is achieved in wear studies on refractory materials by using radioactive tracers bedded in the refractory substance. Unfortunately, development of the method is hampered by the fact that the amount of radioisotope incorporated in the metal products must be strictly limited, and also by diffusion of the radioactive substance in the refractory material. The maximum content permitted in France is 1 mc/500 metric tons of cast metal, and no individual source may exceed 3 mc. Sources specially designed to avoid diffusion phenomena are developed. The essential feature here is the use of pyroceram, a nonporous material with a high fusion point, and great chemical inertness. In these sources the radioisotope can be completely enclosed in the pyroceram or it can form an integral part of the pyroceram's composition. (auth)

16067 WEAR STUDIES IN THE SHEARING PROCESS BY MEANS OF IRRADIATED TOOLS. Toshio Sata, Kunio Abe, and Kiyoshi Nakajima (Inst. of Physical and Chemical Research, Tokyo). p.387-96 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Tool wear in the shearing of sheet metals was studied with punches and dies of irradiated high-speed steel. Circular disks 10 mm in diameter were punched from 0.5-mm-thick low-carbon steel, stainless steel, and silicon steel in dry and lubricated states. After punching, the radioactivity of the disks and the holes was measured. When the radioactive die was replaced by a nonactive one, little radioactivity was detected on the disks, while the radioactivity of the holes scarcely varied. This proved that the wear of the die could be found from the radioactivity of the disks, and that of the punch from the radioactivity of the holes. By this method the wear of the punch and die was followed using different lubricants and sheet metals. At the beginning of punching, the wear rates of both punch and die were very large but rapidly decreased, becoming eventually stationary after punching about four to five hundred pieces. The wear rate of the punch was about 20% greater than that of the die. Lubricants with extreme pressure additives, such as chlorine, phosphorus, or sulfur, reduced tool wear, while refined mineral oils gave little improvement. The heaviest tool wear occurred when punching the harder sheet metals. Tool wear for stainless steel was about three times, and for silicon steel about six times, as large as for low-carbon steel. (auth)

16068 SOME RECENT DEVELOPMENTS IN THE APPLICATION OF RADIOISOTOPE TECHNIQUES IN AUSTRALIA. J. N. Gregory (Australian Atomic Energy Commission Research Establishment, Sutherland, N. S. W.). p.415-31 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Some of the work carried out by the Australian Atomic Commission is described, particularly relating to industrial and field tests. A study of the flow pattern of water in a power-station cooling pond is made, using iodine-131 as tracer. The flow of the water is followed quantitatively throughout the 2×10^8-gal pond by the use of calibrated underwater scintillation counters. These experiments show that the flow pattern is affected by the wind more than by any other factor. In the absence of wind an appreciable fraction of the warm water channels across the surface of the pond and re-enters the power station within 3 to 4 hours. This indicates a design defect in the layout of the intake. A study of the pattern of flow in a Bach subsider for raw sugar solutions is also described. The hot raw solution after lime treatment enters through a single feed line at the top and clarified solution is taken off by pipelines at six different levels. The solids are taken off at the base. About 5 mc of bromine-82 in solution was injected into the feed line and the appearance of the tracer measured quantitatively by shielded scintillation detectors on each of the six outlet pipes. Analysis of the distribution of activity with time in each line permitted a clear indication of the nature of the flow within the subsider. A study of the efficiency of mixing in a spiral-type mixer is also described. (auth)

16069 HIGH-DILUTION ON-STREAM ISOTOPIC TRACER TECHNIQUES. W. H. Johnston, A. F. Findeis, and M. Vestal (William H. Johnston Labs., Inc., Baltimore). p.433-51 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Large-scale tracer applications are reviewed, in which isotope tagging is done on a component of main flowing fluid or stream without subsequent mainline separation.

Equations are derived that relate the required levels of tracer concentrations, the instrumental background, the efficiency of the detector, the required statistical reliability, the time desired for the measurements of sample and background, the stream flow rates, and the tracer nuclide. These equations are shown graphically and allow a ready selection of the tracer concentrations for specific applications. The sampling program for large-scale tracer applications is analyzed for steady state and pulse injections. In the latter case, the longitudinal mixing is treated by the concept of eddy diffusion coefficients. By estimating certain parameters, the longitudinal tracer detection range and the first arrival time are obtained as a function of distance between injection and collection. For high-dilution on-stream radiotracing with beta-emitters, the detectors are large low-level internal-gas-tube counters, foil-flow counters, and plastic scintillators. Anticoincidence counters are presented. The advantages of low-atomic-number shielding are emphasized. Developments in stable transistorized electronics for low-level counting are shown. An amplifier and a tunnel-diode adder circuit are described. Examples are given of applications of high-dilution on-stream tracers to problems of source-identification of pollutions in rivers and streams. (auth)

16070 USE OF RADIOACTIVE TRACERS IN STUDYING THE TRANSPORT OF SOLIDS IN WATERCOURSES. G. Courtois (Centre d'Études Nucléaires, Saclay, France), P. Jaffry, and M. Heuzel. p.453-66 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In French)

Two river experiments were made, the first a study of shingle drifting in the Rhone, the second a study of sand movement in the Niger. The latter experiment was matched by experiments carried out on a scale model of the Niger. The experiments used Mn^{56} and Na^{24} radiation obtained by direct activation of crushed apricot stone, this representing in the scale model the natural sediment of the Niger bed. Attention was devoted to the application of radioactive tracers in studies with scale models, with the aims of: obtaining a research tool for use under natural conditions and with scale models in order to gauge the trustworthiness of the model, in the calibration testing stage; and taking advantage of the facilities for direct observation and measurement offered by scale models in order to study prospects of improving the tracer method, with a view to securing quantitative data. (auth)

16071 THE USE OF Kr^{85} FOR THE MEASUREMENT OF LEAKS IN HERMETICALLY SEALED COMPONENTS. P. F. Berry (Wantage Research Lab., Berks, Eng.), J. F. Cameron, and E. J. Wilson. p.467-75 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Radioactive gases provide a method of leak detection in hermetically sealed components, which in specific cases can be more sensitive by several orders of magnitude than conventional methods of leak detection. The use of Kr^{85} for this purpose is described. The gas can be used in two distinct ways. The first is to immerse the component in the gas under controlled conditions of pressure and time and measure the amount forced in under pressure by subsequent monitoring of the radiation transmitted through the walls of the component. In the second method some active gas is inserted before sealing and the subsequent loss of activity is a measure of the leak rate. The method chosen depends on the dimensions of the component and its proposed use. The chief limitation on the sensitivity in the first method is surface contamination due to absorption of the gas into the pores of the component material; the extent of this is discussed in the application of the method to the detection of leaks in transistor cans. Prefilling the component with active gas before sealing has the advantage that a long-term monitoring of the contents of the component is possible. This eliminates error caused by the possibility of a leak closing up temporarily during the short-term pressure or vacuum test, and provides an integrated value to the leak. (auth)

16072 A MODIFICATION OF THE METHOD FOR DETERMINING CURRENT EFFICIENCY OF ALUMINIUM ELECTROLYTIC CELLS. A. Prądzyński (Inst. of Basic Technical Problems, Polish Academy of Sciences, Warsaw) and Z. Orman. p.477-82 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The specific activity of an $Al\text{-}Au^{198}$ master alloy was reduced by diluting with a known quantity of pure aluminum. Thus samples of diluted master alloy and samples taken from electrolytic cells were of the same order of specific activity and could be measured without any absorber. Radioactivation analysis was employed in order to facilitate the application of the method in aluminum plants and to avoid restrictions and dangers connected with the handling of unsealed radioactive sources outside special radioisotope laboratories. Inactive gold was introduced into the master alloy and into the smelting bath in the electrolytic cell. The concentration of gold in samples of both the master alloy and the smelt was then measured after irradiating the samples. (auth)

16073 CONTINUOUS MEASUREMENT OF GAS FLOW USING A HINGED GATE AND A RADIOACTIVE SOURCE. C. G. Clayton and J. W. Webb (Wantage Research Lab., Berks, Eng.). p.499-509 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

A method for the continuous measurement of volumetric flow of gas in turbulent and laminar condition is proposed using a small radioactive source mounted on a hinged gate. The use of radioactivity enables measurement of the gate-inclination to be made outside the pipe, thus establishing the pattern of a simple instrument. The use of penetrating radiation also results in an extension of the operating range since it allows application of a multi-gate system; an external detector then gives simultaneous measurement of the resultant inclination of several gates. Relationships between volume flow and detector current for single and multiple gate systems are given. (auth)

16074 APPLICATION OF TRITIATED WATER AS A TRACER FOR QUANTITATIVE DETERMINATION OF WATER FLOW DISTRIBUTION IN AN OIL-FIELD. E. Kuyper (Koninklijke/Shell-Laboratorium, Amsterdam), A. Hofstra, and H. Nauta. p.511-17 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

In order to study the flow of water in an underground oil reservoir, tritiated water was injected in a well and tritium was subsequently determined in the water produced by the surrounding wells. Since the specific radioactivity of the water produced by the more remote wells appeared to be rather low, partly owing to dilution of the tritium water by the water present in the formation, enrichment methods were used, in order to increase counting sensitivity. Three methods of enrichment were examined: exchange with ethanol, conversion to toluene, and electrolysis. The last method proved to be the most useful. The tritium was determined with a liquid scintillation counter. The scintillator consisted of a toluene-ethanol (2 : 1) mixture with DPO and POPOP, the water sample being dissolved in this liquid. Some statistical problems in connection with the minimum detectable specific activity and the reduction of background were discussed. (auth)

16075 APPLICATION OF RADIOCHEMISTRY TO THE PREPARATION OF HIGH-PURITY SILICON. Torao Ichimiya, Hideo Bara, and Tadashi Nozaki (Electrical Communication Lab., Tokyo). p.533-42 of "Radioisotopes in the Physical Sciences and Industry. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Radiochemical studies on the preparation of highly pure silicon for semiconductor use were reviewed. The behavior of phosphorus impurity during the purification steps of recrystallization and zone refining was followed using radioactive phosphorus as tracer. The results showed that in each step, hydrolyzed products suspended in the silicon tetraiodide played an important role in removing not only phosphorus but also other impurity elements. Activation analysis was applied to the determination of the arsenic concentration throughout the process and it was indicated that this could be reduced to the order of 10^{-3} ppm after fractional distillation. It was also indicated, by neutron activation analysis, that elemental silicon, after thermal decomposition of the iodide, usually contained several ppm iodine, but its concentration could be reduced by one order of magnitude by a simple fusion. The absorption of soft γ-rays was applied to the determination of iodine concentration in the iodination gas stream and it was found that the principle could be applied to the automatic control of the iodination reaction. (auth)

16076 TRITIUM IN THE PHYSICAL AND BIOLOGICAL SCIENCES. VOL. I. Proceedings of the Symposium on the Detection and Use of Tritium in the Physical and Biological Sciences, held in Vienna, 3-10 May 1961. (International Atomic Energy Agency, Vienna). Proceedings Series. Jan. 1962. 377p. (STI/PUB/39(Vol.I)). $7.00(IAEA).

Twenty-nine papers are included; abstracts were prepared for twenty-six; three papers on tritium content of rainwater from the eastern Mediterranean area, separation of hydrogen, tritium, and tritium hydride by gas chromatography, and rapid assay of tritium labeled substances in Geiger-Mueller gas counting tubes were previously abstracted in NSA. Special emphasis is placed on the role of tritium as a tracer in hydrology, especially in the study of water movement. (P.C.H.)

16077 TRITIUM GEOPHYSICS: RECENT DATA AND RESULTS. W. F. Libby (Univ. of California, Los Angeles). p.5-32 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Results of analyses for natural tritium in recent rain and surface and ground water samples of geophysical interest principally hydrological and oceanographic in various parts of the United States are presented. Data are tabulated. It is concluded that the tritium water method has promise of general geophysical use. (P.C.H.)

16078 LEVELS OF TRITIUM IN A VARIETY OF NEW ZEALAND WATERS AND SOME TENTATIVE CONCLUSIONS FROM THESE RESULTS. A. E. Bainbridge and B. J. O'Brien (Inst. of Nuclear Sciences, Gracefield, N. Z.). p.33-9 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

A wide variety of natural waters was selected for study in the determination of tritium abundance. Results of a series of measurements of tritium from the Akatarawa Stream, near Wellington, from April 1956 to December 1960 are given to show any evidence of bomb tritium in the rains falling on New Zealand. A comparison of these tritium levels with measurements made on tap water at the Institute of Nuclear Sciences was used in an estimate of the storage time of the Hutt Valley Artesian Reservoir. A limited number of results of measurement of tritium in geothermal bore waters, oceanic waters, Wellington rainwater, and alpine snows are presented. (auth)

16079 THE TRITIUM CONTENT OF ATMOSPHERIC METHANE. K. F. Bishop, H. J. Delafield, A. E. J. Eggleton, C. O. Peabody, and B. T. Taylor (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.55-67 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The presence of significant amounts of tritium in atmospheric methane is reported. Methane extracted from air samples obtained from various altitudes in the northern and southern hemispheres showed T/H ratios ranging from 6.3×10^3 to 3.4×10^4 T.U. (1 T.U. equals a T/H ratio of 10^{-18}) during the period September 1957 to February 1959 and a continuous rise in the southern hemisphere from 9×10^2 T.U. in 1953 to 8×10^3 T.U. in 1958. Considerable short-term fluctuations were observed at Wembley, England. The tritiated methane distribution in 1958 was consistent with a tropospheric source (or sources) in the northern hemisphere and the Dobson-Brewer model of global stratospheric circulation. The global integral for tritium in the form of atmospheric methane was very roughly 2.3×10^5 c in 1958. No satisfactory explanation of the source of the tritiated methane was found. (auth)

16080 TRITIUM IN METEORITES AND IN RECOVERED SATELLITE MATERIAL. E. L. Fireman (Smithsonian Astrophysical Observatory, Cambridge, Mass.). p.69-74 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Tritium was measured in separated phases and in whole rock samples of the Bruderheim chondritic meteorite and in samples of lead and iron material of recovered satellites. Radioactive isotopes of argon were also measured. The tritium and argon radioactivity in the Bruderheim meteorite can be reasonably well explained by the interaction of cosmic ray particles of some thousand million volts energy with the meteoritic material. The tritium content of the recovered satellite material was more than a factor of a hundred too large to be explained by the interactions of cosmic rays or by the interactions of solar flare particles with the satellite. The high tritium content of the satellite material must result from a flux of incident tritium particles that stop in the satellite. (auth)

16081 TRITIUM STUDIES IN THE UNITED STATES GEOLOGICAL SURVEY. C. W. Carlston and L. L. Thatcher (Geological Survey, Washington, D. C.). p.75-81 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The Geological Survey is conducting a program of research in laboratory analysis of tritium and in several field projects designed to test the value of tritium in hydrologic research. Laboratory studies were undertaken to improve the gas-phase counting technique and to develop a simple instrumentation adapted to program requirements of long-range hydrologic research. Investigation of various gas-counting mixtures indicates that hydrogen–ether and hydrogen–ethylene mixtures are superior. Electrolytic enrichment was investigated with the objective of improving reproducibility and evaluating separation factors under several conditions. A system that provides 75% tritium recovery on a routine basis was developed. The principal field projects consist in: a tritium study in the Coastal Plain of New Jersey indicating that layering of water of different ages occurs beneath the water table; studies in two different geologic terranes for determination of the fate of tritium fall-out in the 1958 thermonuclear bomb tests; use of tritium to determine ground-water recharge to Tertiary sandstones underlying the semi-arid High Plains of New Mexico; a study of tritium content of the ground water of the Snake River Plain in Idaho to develop information on the age of and rates and direction of movement of water; and use of manufactured tritium as a tracer for determination of the capacity of an underground reservoir near Carlsbad, New Mexico. (auth)

16082 APPLICATION OF TRITIUM TRACER TO CANAL SEEPAGE MEASUREMENTS. W. J. Kaufman and D. K. Todd (Univ. of California, Berkeley). p.83-94 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The problem of seepage loss from water carrier and storage systems and the application of tritiated water to the detection and measurement of such losses are considered. A field study of seepage loss from an 800 ft reach of the Madera Canal, located in the San Joaquin Valley of California, was made. Tritiated water was employed to measure the progress of underground seepage from the canal and the loss of water from an isolated reach of the canal. Velocities of ground water flow were also determined by the point-dilution technique with both chloride and tritium tracers. Laboratory studies of the point-dilution method were conducted for determination of its theoretical validity under controlled conditions and for comparison of the relative efficacies of chloride and tritium. (auth)

16083 THE ELECTROLYTIC ENRICHMENT OF TRITIUM AND DEUTERIUM FOR NATURAL TRITIUM MEASUREMENTS. H. G. Oestlund and E. Werner (Lab. for Radioactive Data, Stockholm). p.95-104 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Agency, 1961. (In English)

An electrolytic enrichment method is described, in which a 250 ml sample is electrolyzed in one cell to a final volume of 2.5 ml, or even less. In order to keep the electrolyte concentration within the tolerable limits, only a fraction of 50 ml of the sample takes part in the reaction, and by periodic addition in portions, the total sample is gradually introduced into the reaction zone. This method gives apparent enrichment factors for deuterium, α', and for tritium, β', which vary according to the relationship $\eta' = \log \beta'/\log \alpha' = 1.369 \pm 0.006$. If this result is applied to conventional batch electrolysis the result may be written $\eta = \log \beta/\log \alpha = 1.337 \pm 0.007$. The experimental results, when furthermore corrected for vapor loss, are in excellent agreement with the prediction on theoretical grounds that $\log \beta_0/\log \alpha_0 = 1.40 \pm 0.01$. (auth)

16084 THE RECONCENTRATION OF TRITIUM BY DISTILLATION. D. B. Smith and D. S. Rawson (Wantage Research Lab., Berks, Eng.). p.105-20 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

A method of tritium reconcentration by the total reflux distillation of water under reduced pressure using random-packed columns was investigated. For the maximum removal of tritium from a one liter reservoir, operating periods of several weeks were required. For this a fully automatic fractionating system incorporating an apparatus for taking samples automatically under reduced pressure was developed to enable the distillation to proceed with the minimum of manual adjustment. To reduce the possibility of flooding at the base of the column due to gravity settling of the packing over long periods of time, a novel design feature was incorporated at the junction of the column and the reflux meter. The performance of several commercially available column packings was investigated in an aqueous environment. Details of the packing pre-treatment to inhibit maldistribution in a liquid of high surface tension are given and enrichment factors calculated. A low H.E.T.P. (height equivalent to a theoretical plate) of about 0.8 in. was achieved with pre-treated phosphor-bronze gauze rings in an aqueous environment. With a reservoir-to-boiler volume ratio of the order of 7 : 1, a maximum of 98% of the tritium in the reservoir was removed in 28 days continuous distillation with a throughput of 100 ml/hr. This indicated a tritium reconcentration factor of 6.3. By increasing the throughput to 140 ml/hr, 92% of the tritium was extracted in 11 days. The reproducibility of the reconcentration factor with time was, however, shown to vary, and the reasons for this are discussed. (auth)

16085 THE SEPARATION OF HYDROGEN, TRITIUM AND TRITIUM HYDRIDE BY GAS CHROMATOGRAPHY. H. A. Smith and E. H. Carter, Jr. (Univ. of Tennessee, Knoxville). p.121-33 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Studies were made on the separation of hydrogen, tritium, and tritium hydride mixtures. Since tritium is used in tracer quantities the usual katharometer could not be employed for its detection. This difficulty was overcome by providing, immediately following the katharometer, a vibrating reed electrometer equipped with a high resistance leak which allows continuous monitoring of the activity of any tritium or tritium hydride emerging from the column by means of synchronized recorders. Separation of the mixtures was tested with columns packed with palladium on silica, silica, alumina, and alumina coated with chromium or ferric oxides. No effective separation was obtained with the palladium on silica column. Good separation was achieved with the plain silica column where hydrogen was employed as the carrier gas, but helium failed to elute the isotopes. Satisfactory results were obtained with the coated, partially deactivated alumina packing when helium or neon was the carrier gas, but the best separation was found with a column packing of uncoated activated alumina. Calibration with helium–tritium mixtures of known activity plus equilibrated hydrogen–tritium mixtures also of known activity allows quantitative estimation of tritium and tritium hydride. (auth)

16086 ISOTOPE EFFECTS ACCOMPANYING USE OF TRITIUM AND DEUTERIUM IN THE STUDY OF ORGANIC RADIATION CHEMISTRY. J. G. Burr (Atomics International, Canoga Park, Calif.). p.137-52 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Studies were made on the types of isotope effects which must be considered in using tritium and deuterium to study the radiolysis of organic compounds. Over-all isotope effects are defined for several types of labeling such as the use of partially-labeled materials (where the labeling is either random or specific) and mixtures of wholly-labeled with wholly-unlabeled substrates. Contributions to the over-all isotope effect are analyzed in terms of isotope effects in excitation processes; the dissociation of excited molecules; and secondary radical reactions. The quasi-equilibrium theory of molecule-ion dissociation is used to estimate quantitatively the isotope effects accompanying loss of hydrogen and deuterium atoms from biphenyl molecule-ions; this application is discussed. It is shown how scavenger techniques can be used to estimate the isotope effect accompanying loss of hydrogen and deuterium by non-radical processes in the radiolysis of deuteriated methanols. Existing literature concerning isotope effects in the secondary radical reactions is summarized critically. The existence of pronounced secondary isotope effects in the formation and reactions of deuterated aliphatic radicals is emphasized. (auth)

16087 STUDIES ON THE MECHANISM OF THE CANNIZZARO REACTION. A. L. Powell, C. G. Swain, and C. R. Morgan (Massachusetts Inst. of Tech. and Office of Naval Research, Cambridge, Mass.). p.153-60 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962.

An intensive investigation of the mechanism of the Cannizzaro reaction was undertaken. An isotope dilution technique was employed with p-t-C_6H_5CHO in 74% methanol solution at 100°C in order to determine the presence of a reaction intermediate. The kinetics of the homogeneous benzaldehyde Cannizzaro reaction, the second-order rate constant for the hydrolysis of benzyl benzoate and the kinetics of the hydrolysis of p-t-benzyl benzoate-p-t were studied in 74% methanol at 100°C. It was shown that an intermediate ester is not present in the early stages of the Cannizzaro reaction. It was demonstrated that the hydrolysis of benzyl benzoate under Cannizzaro conditions is very fast. Calculation of the concentrations of ester which should be present in the Cannizzaro reaction showed that these quantities are well within the range of detection of the sensitive radiotracer technique employed. It was concluded that the mechanism of the Cannizzaro reaction involves an intermolecular hydride ion shift rather than an intramolecular H: transfer. A deuterium isotope effect of 0.50 found for this reaction indicates that the proton transfer takes place in a rapid subsequent step rather than simultaneously with the hydride shift. (auth)

16088 GENERAL RULES GOVERNING THERMODYNAMIC ISOTOPE EFFECTS IN TRITIUM/PROTIUM EXCHANGE. Ya. M. Varshavskii (Inst. of Radiation and Physico-Chemical Biology, Academy of Sciences, USSR). p.169-77 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In Russian)

The marked difference between the mass of tritium and hydrogen causes a significant difference in the chemical characteristics of these two isotopes of hydrogen, and, in particular, an extremely irregular distribution of tritium among hydrogenous substances during tritium–hydrogen exchange. The coefficients (α) of tritium distribution in various systems of hydrogenous substances are calculated by a method based on statistical thermodynamics, giving a quantitative measure of the thermodynamic isotope effect. It is shown that for some systems (containing hydrides of alkali metals) the value of α may attain 20. (auth)

16089 THE DETERMINATION OF SUB-MICROGRAM QUANTITIES OF AMINO ACIDS WITH H^3- AND C^{14}-LABELLED 1-FLUORO-2.4 DINITROBENZENE. D. Beale and J. K. Whitehead (Middlesex Hospital Medical School, London). p.179-90 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

A method of isotope derivation analysis is described for the estimation of amino acids at levels as low as 10^{-5} μM in protein hydrolysates. 1-fluoro-2,4-dinitrobenzene-H^3 (G) was synthesized from bromobenzene-H^3 (G), and 1-fluoro-2,4-dinitrobenzene-C^{14} (G) was prepared from chlorobenzene-C^{14} (G). The method of analysis involves the treatment of the amino acids mixture with the tritiated reagent (specific activity 12.8 μc/μ-equivalent) in alkaline solution followed by the addition of known activities (6000 dpm) of C^{14}-labeled 2,4-dinitro phenyl derivatives. After solvent extraction the reaction mixture is separated into its constituent dinitro phenyl derivatives by two-way paper chromatography, and the H^3 and C^{14} contents of each spot are determined by combustion and gas counting. The H^3 count gives a measure of the amount of DNP derivative of amino acid isolated from the original mixture, and the C^{14} count gives a measure of losses incurred during the analysis. Results obtained from the analysis of μg of hydrolyzed insulin are in good agreement with values obtained by derivative analysis with H^3 and C^{14}-labeled acetic anhydride and by ion exchange resin chromatography. (auth)

16090 MEASURING THE SPECTRA OF TRITONS IN NUCLEAR REACTORS. A. A. Ogloblin and V. I. Chuev (Kurchatov Inst. of Atomic Energy, Academy of Sciences, USSR). p.191-200 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In Russian)

A proposed method for measuring the energy and angular distributions of tritium nuclei formed in nuclear reactors is described. Around the target being bombarded by a beam of charged particles are arranged piles of foil, in which the escaping tritons are caught. After irradiation the tritium is separated from the foil and its activity measured by a Geiger counter. Characteristic features of the method are the complete absence of background from other charged particles and the possibility of simultaneously measuring the spectra at broad energy and angular intervals. (auth)

16091 LIQUID SCINTILLATION DETECTION OF TRITIUM AND OTHER RADIOISOTOPES IN INSOLUBLE OR QUENCHING ORGANIC SAMPLES. J. F. Eastham, H. L. Westbrook, and D. Gonzales (Univ. of Tennessee, Knoxville). p.203-9 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

To facilitate a study of the H^1/H^3 isotope effect in the reduction of organic compounds, procedures were developed to overcome the two major limitations of the liquid scintillation counting organic material. These limitations, which are scintillation-quenching by many organic samples and limited solubility of others, are particularly common with material of biological significance. The procedures developed involve combustion of the sample wrapped in filter paper in an oxygen-filled flask, formation of a solution of the combustion products in a suitable solvent added to the flask before combustion, and scintillation-counting of the solution. Advantages of the developed procedures, in addition to overcoming the indicated limitations, include efficacy with samples with a great range of activity (some as low as 1 μc/mole), good precision (as great as any other general method of radio-assaying H^3), and applicability to other soft beta emitters (C^{14} and S^{35}). With a scintillation spectrometer and the techniques developed, samples triply labeled with H^3, C^{14}, and S^{35} can be differentially radioassayed. Details of the solvent systems and techniques developed are reported. Analytical results are reported for such quenching materials as 2,4-dinitrophenyl-hydrazones dyes and for such insoluble materials as proteins and carbohydrates. Application of the techniques to evaluation of H^1/H^3 isotope effects in certain reduction reactions are discussed. (auth)

16092 PHOTOMULTIPLIERS FOR TRITIUM COUNTING. J. Sharpe and V. A. Stanley (E. M. I. Electronics Ltd., Hayes, Eng.). p.211-29 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The development of tubes giving a high ratio of photosensitivity to dark counts and improvements obtained by a combination of processing and geometry changes, which give satisfactory performance at room temperature with a single tube arrangement, are discussed. Efficiencies around 15% in toluene solution with a tube background of between 30 and 180 cpm are readily obtainable. The advantages of cooling and the problem of obtaining the best performance from a coincidence arrangement, with particular reference to the phenomen of talk back, are also discussed. The fundamental aspects of dark emission in photomultiplier tubes are considered in the light of the discussion, and predictions regarding ultimate performance are hazarded. (auth)

16093 A LOW-BACKGROUND LIQUID-SCINTILLATION COUNTER FOR THE ASSAY OF LOW-SPECIFIC-ACTIVITY TRITIATED WATER. I. S. Boyce and J. F. Cameron (Wantage Research Lab., Berks, Eng.). p.231-47 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

A counting system for detecting low specific-activity tritium in water is given. To investigate low level counting, a coincidence system was selected to avoid uncertainties in the background due to single photon events arising from phosphorescence and chemiluminescence in the solution. With this system the background was found to be due largely to light originating in the photomultiplier photocathode. Using two photomultipliers with Pyrex photocathodes in contact in an 8-in. thick iron shield, experiments were conducted to determine the relative importance of the following possible courses of background: ionization and excitation of residual gas and of the semiconductor dynode surfaces, particularly in regions where the current density is greatest; sparking, electroluminescence, and field emission; positive ion feedback to the photocathode causing secondary electron emission; and operation of the photocathode window itself as a phosphor for cosmic radiation, K^{40} beta particles, or radiation from uranium daughter products. In particular it was found that positive ion feedback was significantly lower than was previously supposed. Methods of minimizing these effects, including the use of quartz photocathodes, and special photomultipliers were investigated. In the finished design of the counter the minimum detectable specific activity with a counting time of 30 min is 6×10^7 μc/ml. (auth)

16094 RECENT ADVANCES IN LOW-LEVEL SCINTILLATION COUNTING OF TRITIUM. W. J. Kaufman, A. Nir, G. Parks, and R. M. Hours (Univ. of California, Berkeley). p.249-61 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Studies were made of the liquid scintillation counting system with the objective of optimizing detection sensitivity as expressed by a function of sample volume, efficiency, and background. The investigation included a review of scintillator composition. A dioxane–naphthalene–water system having a water content of 18.6% was selected as the most satisfactory composition. Further studies of counting cell geometry and scintillator volume led to the use of a cylindrical container of Teflon with high gain quartz face photomultipliers in direct contact with the solution. This system gave a tritium detection sensitivity corresponding to a concentration of 0.55×10^{-12} c/ml at an efficiency of 6.9% and a background of 52 cpm. A water sample volume of 31.6 ml was used with total scintillator volume of 170 ml. An internal Co^{57} source was found to be a suitable monitor of tritium-counting efficiency in the range 2 to 7% with a standard deviation of 0.1%. It has the advantage over previous methods in that it provided a rapid efficiency determination without modification of the sample. Studies of background reduction were made to evaluate the contribution of luminous interaction and cosmic radiation. A plastic envelope anticoincidence shield was used in the study. Long term effects on stability of the system caused by sample deterioration and counting equipment drifts were evaluated. (auth)

16095 PHOSPHORESCENCE IN LIQUID SCINTILLATION COUNTING. R. A. Lloyd, S. C. Ellis, and K. H. Hallowes (Wantage Research Lab., Berks, Eng.). p.263-79 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Phosphoresence of materials likely to be incorporated in a scintillation counting system was studied. The effect of time of excitation and the variation with over-all detection efficiency was investigated. Some selected liquids of very high purity were also included. An analysis of the decay curves was made, and the results evaluated in terms of a practical counting system. (auth)

16096 RADIO COLUMN CHROMATOGRAPHIC ASSAY OF H^3-LABELLED SUBSTANCES. H. W. Scharpenseel and K. H. Menke (Universität, Bonn). p.281-302 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

For assaying tritium labeled column effluents two approaches appear most feasible: The column effluent is passed through a coil of plastic scintillator tubing, which is wound around a plexiglas cylinder and placed in a bath of silicone oil in a light pipe with TiO_2 reflector, or the effluent can be directed through a test vial, filled with plastic scintillator beads. These two approaches, that operate highly satisfactorily in the case of C^{14}, offer low counting efficiencies of less than 1% for H^3 due to unfavorable surface to volume ratio. The column effluent is combined 1:30 with a mixture of 3:2 toluene/ethanol by the action of a magnet vibrator before being assayed while passing through a K^{40}-free glass, coiled between the analyzer and monitor phototubes. In order to ensure a laminar flow and constantly mixed volume ratio, dose pumps are used for the supply of buffer on the column and of the 30 fold volume of toluene/ethanol. The counting efficiency for H^3 averages 2.5 to 4% for coils spreading over the whole diameter of the phototubes. The aqueous column effluent is led through an anthracene filled glass tube and the H^3 counted with close to 1% efficiency. (P.C.H.)

16097 A NEW METHOD FOR MEASURING LOW LEVEL TRITIUM USING A BENZENE LIQUID SCINTILLATOR. M. Tamers, R. Bibron, and G. Delibrias (Centre d'Études Nucléaires, Saclay, France). p.303-12 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The tritium activity of rain and free hydrogen may be determined by converting the samples to benzene and counting in a liquid scintillation counter equipped with coincidence and cooling. The water to be measured (the hydrogen samples can be easily and quantitatively converted to water) is added to commercial calcium carbide and acetylene collected. This gas is led into a glass circuit containing a quartz tube heated to 600°C, two traps cooled to dry-ice temperatures, and an all-glass circulating pump. The acetylene polymerizes to a variety of products which are removed continuously by the traps. After virtually all of the acetylene has reacted, the benzene in the traps is separated by distillation. The benzene is then purified by extractions. Naphthalene is added to the benzene to reduce the freezing point. The present arrangement, which utilizes a counting container of 20 ml, permits 1.2 g of hydrogen to be counted with a background of 25 cpm. The detection efficiency is 35%. Due to the large quantity of hydrogen exposed to the counter, it is possible to measure atmospheric samples without the necessity of isotopic enrichment. (auth)

16098 DIRECT MEASUREMENT OF TRITIUM IN BIOLOGICAL MATERIALS WITH THE LIQUID SCINTILLATION COUNTER. K. Halvorsen (Institutt for Atomenergi, Kjeller, Norway). p.313-23 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

A single phototube liquid scintillation counter was used for the measurements of tritium in animal tissue. Investigation centered primarily on the direct dissolution of animal tissue in Hyamine 10-X and the suspension counting of lyophilized tissue in scintillating gels. Different tissues, such as liver, intestine, blood, and skin, can be dissolved directly in Hyamine and measured with an efficiency of 10–15%. The techniques of quenching correction and certain phosphorescence phenomena as they affect the counting in a single phototube counting system are discussed. The sensitivity of the method, although somewhat less than that of the coincidence-counting arrangement, seems to be sufficient for many applications. Work was carried out on tissue samples from mice previously injected with tritium-labeled thymidine. When a dose of approximately 1 μc tritiated thymidine per g of body weight was injected into the mice, the metabolic fate of the thymidine incorporated into deoxyribonucleic acid (DNA) of the various tissues could be followed for a period of one month. (auth)

16099 A LOW-LEVEL GEIGER-COUNTER FOR TRITIUM. H. Von Buttlar and W. Stahl (Technische Hochschule, Darmstadt, Ger.). p.325-31 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

A cylindrical counter tube of volume 11 l was constructed which contains a number of anticoincidence wires surrounding a 2.9 l effective-volume center-counter. The center counter is separated from the anticoincidence section by a thin aluminized Hostaphan foil. Details of the construction are given. The counter filling gas consists of 30 mm ethylene, 40 mm argon and up to 700 mm sample hydrogen. An external quenching circuit with a 7 msec dead time effectively eliminates after-pulses. In a 30 cm iron shield, the counting rates of the center counter with dead hydrogen gas are 350 counts/min without and about 3 counts/min with the anticoincidence circuit in operation. If it is assumed that 1 count/min above background is significant, a T/H ratio of as low as 10^{-16} can be measured without isotope enrichment. Experiments are in progress to check the longtime stability of the arrangement. (auth)

16100 A HYDROGEN GAS COUNTING SYSTEM FOR NATURAL TRITIUM MEASUREMENTS. G. Oestlund (Lab. for Radioactive Data, Stockholm). p.333-41 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

An apparatus in which a water sample of about 1 g is reduced by magnesium to hydrogen and then fed directly to a 1-liter counting tube is described. The counting gas should contain 10 mm of propane in addition to 750 mm of the sample hydrogen. In conjunction with electronic quenching, the counter works in the Geiger region with excellent plateaus, reproducibility, and long-range stability. With a heavy shielding and anticoincidence technique, the background is 2.25 cpm. Many present-day rains having tritium molar fractions of T/H of the order of 6×10^{-18} or more might be measured without enrichment, and in other cases the enrichment requirement is modest. (auth)

16101 THE MEASUREMENT OF NATURAL TRITIUM LEVELS IN GEIGER COUNTERS. B. J. O'Brien (Inst. of Nuclear Sciences, Gracefield, N. Z.). p.343-51 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

A method for the counting of tritium in a 300 ml gas counter with internal quenching gases is described. Originally a system with ethylene–argon as a quenching gas was used in conjunction with an anticoincidence ring. The anticoincidence count-rate plateau characteristics were unsatisfactory at low count rates because of unsatisfactory quenching, and a search was made for more efficient quenching gases. The source of the background count-rate plateau slope is discussed, and the properties required of a suitable quenching gas for hydrogen counting are given. Results of a study made of the counting characteristics of hydrogen quenched with benzene, ethylbromide, ethyl ether, isopropyl amine, hexane, ethylamine, and isoprene are given. Ethylamine and ether in particular gave very satisfactory quenching characteristics. A counting system with a counter filled with 40 cm of hydrogen and quenched with ethylamine is described. The background rate is 3 cpm with a comparatively flat background plateau. (auth)

16102 A ZINC FUSION METHOD FOR THE DETERMINATION OF TRITIUM IN BIOLOGICAL MATERIAL BY GAS COUNTING. J. Hasan (Työterveyslaitos, Helsinki). p.361-9 of "Tritium in the Physical and Biological Sciences. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The conversion of organic compounds to a mixture of hydrogen and methane by mixture with metallic zinc and suitable catalysts offers a convenient means for the determination of tritium in organic material by gas assay. It was found, however, that, at least in proportional counting, compounds of certain types do not give reliable results with this method; and when a trial of its application to animal tissues was made, the results were extremely inaccurate. As the principle seemed to offer several advantages over other methods, a search was conducted for reagents which would render it usable with biological material. It was found that, when up to 10 mg of animal tissue, such as blood, muscle, and liver, containing or mixed with various tritiated compounds were heated for 3 hr at 650°C in an evacuated and sealed tube of special glass together with sufficient amounts of metallic zinc powder, nickel oxide, and anhydrous sodium carbonate, gas which could be assayed in brass cathode proportional counters filled to atmospheric pressure with inactive methane was

produced. Above 4000 v the counters filled with this gas mixture exhibited plateaus several hundred volts long and with a slope less than 1% per 100 v. This method for conversion of biological material to a suitable gas for proportional counting was found to be readily reproducible with a mean accuracy of within better than 3%. No serious memory effects were noted, even with samples of rather high specific activity. (auth)

BIOLOGY AND MEDICINE

General and Miscellaneous

Refer also to abstracts 16098 and 16102.

16103 (CEA-2112) DETERMINATION DU VOLUME SANGUIN TOTAL CHEZ LE RAT A L'AIDE DU CHROME 51. (Determination of the Total Blood Volume of the Rat Using Chromium 51). Y. Bernard and R. Rinaldi (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Grenoble). 1962. 8p.

A method for determining the blood volume of a rat by simply weighing the animal was developed. Cr^{51} was used to measure the blood volume of rats with different weights. Results showed that the blood volume per 100 g is 5.55 ml and that it does not appear to vary with the weight of the animals. (auth)

16104 (PAN-252/X) ISOLATION AND PURIFICATION OF A GLYCOPROTEIN FRACTION FROM FIBRINOGEN DIGESTED BY PLASMIN. B. Lipiński and E. Kowalski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 9p.

A method of isolation and purification of the thermostable glycoprotein fraction, Fibrinogen-derived Glycoprotein, (FDG) from a fibrinogen lysate is described. FDG possesses only one N-terminal group and this together with the results of the electrophoretic and sedimentation analysis (s_{20} = 2.8 S) indicate the homogeneity of this preparation. Further analysis of FDG revealed a high content of hexoses and hexosamines. (auth)

16105 THE USE OF ISOTOPIC MIXTURES FOR IN VIVO MEASUREMENT: TECHNICAL IMPROVEMENTS IN THE EXAMINATION OF THYROID FUNCTIONS MADE WITH TRACERS. G. L. Buraggi and J. Dutreix (Università, Milan). Minerva nucleare, 5: 349-56(Dec. 1961). (In Italian)

Measurements of radio-iodine uptake in the thyroid involve an error due to the presence of the tracer in extrathyroidal spaces of the neck. Several methods have been suggested in order to correct this error of these, the simplest and most widespread consists in subtracting from the values obtained at the level of the neck those obtained in a region of the thigh whose diameters almost correspond to those of the neck. The correction is, however, incomplete, especially when the measurements are made immediately after administration of the tracer. A method for the exact determination of the thyroid activity using an isotope mixture $I^{131} + Br^{82}$ is proposed. The theoretical principles, the experimental controls, and the results obtained in a first group of patients are described. (auth)

16106 THE CALIBRATION AND STANDARDIZATION OF THYROID RADIOIODINE UPTAKE MEASUREMENTS. REPORT OF GROUP OF CONSULTANTS OF THE INTERNATIONAL ATOMIC ENERGY AGENCY. Phys. in Med. Biol., 6: 533-40(Apr. 1962).

The use of iodine-131 for the assessment of thyroid function by means of the 24-hour uptake determination is discussed from the point of view of standardization of procedure. Recommendations are made about the amount of the tracer dose, the method of its administration, the use of standards and phantoms, the type of detecting equipment and the position of the patient. (auth)

16107 "IN VIVO" MEASUREMENT OF THE BONE MARROW CONTENT OF THE HUMAN BODY BY USING RADIOACTIVE IRON. F. Di Pietrantonj (Università, Palermo, Italy). Radiol. med., 48: 59-66(Jan. 1962). (In Italian)

An original method for determining the bone marrow content of the whole-body is described. This method is essentially based on the principle of isotopic dilution: the ratio between the injected radioactivity (radioiron) and erythroblastic radioactivity found in a bone marrow sample, serves to estimate the number of erythroblasts present in the body. The author has studied some techniques and worked out a calculation method which help to increase the reliability of the determinations, correcting some of the most important causes of error inherent in the abovementioned scheme of estimation. (auth)

16108 RADIOISOTOPES AND RADIATION IN ENTOMOLOGY. Proceedings of the Symposium on Radioisotopes and Radiation in Entomology held in Bombay, 5-9 December 1960. (International Atomic Energy Agency, Vienna). Proceedings Series. Jan. 1962. 322p. (STI/PUB/38). $6.50 (IAEA).

Twenty-five papers are included on problems and uses of radioisotopes and radiation as tools in the fight against insects and pests, which damage agricultural crops and livestock. Twenty-four papers are abstracted, one paper on radioactive tracer techniques in insect biochemistry was previously abstracted in NSA. (P.C.H.)

16109 RADIOISOTOPES IN ECOLOGICAL AND BIOLOGICAL STUDIES OF AGRICULTURAL INSECTS. D. W. Jenkins (Army Chemical Corps, Fort Detrick, Frederick, Md.). p.1-21 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

Research completed or in progress on the use of radioisotopes in biological and ecological studies of insects of agricultural and veterinary importance is summarized, and new avenues of approach for insect-control using radioactive materials are suggested. The many uses of radioisotopes are discussed and the various radioisotopes used are listed. 118 references are given. (P.C.H.)

16110 THE USE OF RADIOISOTOPES AND RADIATION IN THE FIELD OF PLANT PROTECTION. S. V. Andreev, B. K. Martens, and V. A. Molchanova (All Union Research for Plant Protection, Leningrad). p.23-37 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In Russian)

Investigations being carried out in the Soviet Union with a view to working out methods of using radioisotopes and ionizing radiation for the solution of theoretical problems and for carrying out practical work in the field of plant protection are discussed. Ionizing radiation is used for its effects on microorganisms, crop seeds, and insects. By means of the effects of ionizing radiation on microorganisms, strains of entomopathological fungi (Beanveria bassiana and Aspergillus flavus) of increased virulence have been produced. Sterilizing doses for stored products pests have been worked out and used as the basis for the design of a gamma deinsector. The use of isotopes as tracers has made it possible to follow the dynamics of the movement of insecticides within plants and within the organisms of pests; to make a comparative evaluation of toxic agents having a systematic action; and to ascertain the duration of the toxic characteristics of such agents in plants and agricultural produce, which is very important for defining the safe time-limits for using toxic agents on agricultural crops. For studying the selective action of the 2,4-D herbicides, the concentrations of herbicides as governed by additions of mineral oils were determined. Further uses of radioisotopes in labeling toxic chemicals and agricultural pests are also discussed. (auth)

16111 RADIOLABELLING OF ANTS IN PINEAPPLE PLANTATIONS. M. Mortreuil and I. M. Brader (Institut d'Études et de Recherches Tropicales, Adiopodume, Cote d'Ivoire, France). p.39-45 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In French)

Radiolabeling methods of studying certain structural aspects of ant-cochineal associations (*Pheidole megacephala* [F] and *Pseudococcus brevipes*) in pineapple plantations are discussed. The special feature of radiotracers is that, contrary to the usual methods, it is possible with them to visualize exactly the dimensions of the nests and the ground their influence extends to, without disturbing the ecological and demographic equilibrium. (auth)

16112 METABOLISM OF ORGANOPHOSPHATE INSECTICIDES BY PLANTS: A REVIEW. J. E. Casida (Univ. of Wisconsin, Madison). p.49-64 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

Current knowledge of the metabolic fate of insecticides in plants is reviewed with particular attention to the synthetic routes available for labeling organophosphates with P^{32} and the use of these compounds in metabolism studies. It is felt that radioisotopes provide the most certain method for establishing the metabolic pathway of an insecticide. A table on radiotracer studies on the metabolism of organophosphate insecticides by plants is given. 104 references are included. (P.C.H.)

16113 METABOLISM OF SYSTEMIC AND OTHER RECENT INSECTICIDES IN ANIMALS. B. W. Arthur (Auburn Univ., Ala.). p.65-82 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

Typical biochemical mechanisms are discussed, with specific systemic and non-systemic organophosphate insecticides as illustrations. Organophosphates undergo several activation and detoxication processes in insects and mammals. Detoxication mechanisms of organophosphates include destructive hydrolysis at the P—O—C, P—S—C, P—C, P—N, or P—O—N bonds. Other hydrolytic processes occur at groups not linked to the phosphorus atom. It is stressed that insecticide metabolism studies are basic in understanding the selective toxicity of insecticides, resistance mechanisms, residue problems, and mode-of-action concepts. 103 references are given. (P.C.H.)

16114 CL^{36}-DIELDRIN IN MICE. D. F. Heath (Medical Research Council Labs., Carshalton, Surry, Eng.). p.83-91 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

The distribution of Cl^{36}-Dieldrin injected intravenously into mice (LAC grey strain) was studied. Extraction of Cl^{36}-Dieldrin from tissues proved difficult, and experimental techniques are described in detail. Shortly after injection, high concentrations were found in the liver and brain, but the compound rapidly dispersed and, 24 hr after injection, was mainly in the fatty tissues. Very little was excreted, some was probably metabolized. An attempt is made to relate these findings to the toxic effects. (auth)

16115 METABOLISM OF RADIO-LABELLED SYSTEMIC INSECTICIDES IN ANIMALS. D. E. Weidhaas, C. H. Schmidt, and W. F. Chamberlain (U. S. Dept. of Agriculture, Orlando, Fla.). p.93-8 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

A summary is presented of research work on the metabolism of radio-labeled systemic insecticides in animals, with details on experimental procedures and important results. Analyses of samples of blood, urine, feces, meat, and milk are made by various methods in order to trace the fate of an insecticide or its associate residues in an animal. Results are cited for numerous insecticides. Studies are also included in which radioisotopes are used to aid research on the mode of action of insecticides and repellents, metabolism of insect repellents, and insecticide resistance problems. (auth)

16116 RADIOISOTOPE TECHNIQUES AND RECENT RESEARCH ON METABOLISM OF INSECTICIDES IN INSECTS. T. L. Hopkins (Kansas State Univ., Manhattan). p.101-11 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

Techniques useful for investigations of radioisotope labeled insecticides and insects and their application to the study of insect mechanisms of resistance are reviewed. Data are presented on the quantitative fate and metabolism of P^{32} labeled Dipterex, 0,0-dimethyl 1-hydroxy-2,2,2-trichloroethyl phosphonate, in normal and Dipterex resistant houseflies. The resistant fly strain was able to detoxify the insecticide and excrete the water soluble metabolites at a more rapid rate than the normal flies. Metabolites were identified by paper chromatography, and no qualitative differences were found between strains. (auth)

16117 RADIOISOTOPES AND THE INSECT CENTRAL NERVOUS SYSTEM. J. E. Treherne (Cambridge Univ., Eng.). p.137-44 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

Investigations on the influx of various radioactive compounds through the continuous cellular and fibrous membrane which envelopes the nervous system are discussed. It is currently believed that the perilemma functions as a diffusion barrier restricting the entry of such substances as sodium and potassium ions and acetylcholine into the underlying nervous tissue. An attempt was made to understand this and other possible processes by studying the uptake of C^{14} labeled molecules in the abdominal nerve cord of the cockroach. At the same time, experiments were conducted to learn something of the biochemical events in insect nervous tissue by following the metabolism of some labeled compounds in the nerve cord of the cockroach. Results are discussed in relation to current concepts of the physiology of the vertebrate nervous system. Conclusions about the nature of the permeability processes associated with the perilemma are felt to have some important implications in relation to insect toxicology. (P.C.H.)

16118 A STUDY OF THE PHOSPHOLIPIDS OF DIELDRIN-RESISTANT AND SUSCEPTIBLE HOUSEFLIES, WITH PARTICULAR REFERENCE TO THOSE OF THE THORACIC GANGLION. R. G. Bridges, H. D. Crone, and J. R. Beard (Agricultural Research Council, Slough, Bucks, Eng.). p.145-53 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

A study of housefly phospholipids was made because of the possibility that some alteration in membrane structure or active transport is implicated in the mechanism of Dieldrin-resistance in insects. The phospholipids of a Dieldrin-resistant strain of housefly and of a susceptible strain from which it was derived were labeled by feeding the flies on P^{32}-labeled orthophosphate solution for 24 hr and then allowing them to metabolize the adsorbed P^{32}-phosphate for periods up to 336 hr. Thoracic ganglia were removed and the phospholipids separated by chromatography on silicic acid impregnated paper strips. Four major phospholipid fractions can be separated which appear to be the same as those obtained from extracts of whole flies. In the case of whole fly extracts the identity of the fractions is as follows: fraction II phosphatidyl inositol, fraction III lysocephalin, fraction IV a mixture of phosphatidyl choline and an unidentified phospholipid, and fraction V phosphatidyl ethanolamine and phosphatidyl serine. Fraction I consists of non-phospholipid phosphorus-containing compounds. Maximum labeling of the fractions was obtained after feeding the flies (on glucose and water) for one week after removal from the P^{32}-phosphate. The distribution of the P^{32}-activity in the separated fractions from the ganglia of the resistant and susceptible fly showed no significant differences at the time of maximum labeling. There was, however, some evidence for a slower turnover of P^{32}-activity into the two major phospholipid fractions (IV and V) from the resistant fly. This was made more obvious when the flies were fed on milk in addition to glucose and water. Preliminary studies on turnover for much shorter periods were carried out on phospholipid extracts from whole flies injected with P^{32}-labeled orthophosphate solution. These showed a more rapid turnover of P^{32}-activity into the phosphatidyl inositol fraction (II) in the case of the resistant flies, although in these short-term experiments there seems to be no difference in turnover into fractions IV and V from the two strains. The possible significance of the findings is discussed. (auth)

16119 STUDIES ON THE PERSISTENCE, DECAY AND DISTRIBUTION OF RADIOPHOSPHORUS IN GRASSHOPPERS AND THE MADEIRA COCKROACH. H. Huque (Ministry of Food and Agriculture, Karachi, Pakistan). p.155-62 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

Three species of grasshoppers and the Madeira cockroach were labeled with P^{32} for persistence, decay, and distribution studies. The persistence of P^{32} in the grasshoppers and the Madeira roach was detected in measurable quantities beyond 30 days, while the biological half life was found to range from 6.8 to 7 days in grasshoppers and 8.5 to 10 days in the Madeira roach. Radiophosphorus, when introduced into test insects in reasonable quantities, showed no toxic or detrimental effects on any stage of development of the insects. P^{32} was found in the cast skin and the oöthecae of the Madeira roach. Very small amounts of radioactivity were found in the egg capsules of the grasshoppers but not in their exuviae. The distribution of P^{32} in both insects (grasshoppers and the roach) was very similar after 48 hr. The distribution study was also checked by radioautograph techniques. Radioautograph plates revealed that the concentration of the isotope was greatest in the region of the hind gut and the metathoracic legs. (auth)

16120 TECHNICAL PROBLEMS OF RADIOISOTOPE MEASUREMENT IN INSECT METABOLISM. W. Kloft (Universität, Würzburg, Ger.). p.163-72 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

The use of β emitting isotopes as tracers in insects is accompanied by certain complications when measurements are made on intact insects. Technical and mathematical ways of determining the value of the absorption and backscattering are described, and mention is made of the problem of cuticular excretion of P^{32}, with subsequent changes in counting rates. All such complications are greatly reduced if γ sources are used as tracers and the measurements made with scintillation counters. If the γ and β radiations from the same insect are measured in close succession in the experiments described, the size of the effects may be easily determined for the particular isotope used. (P.C.H.)

16121 SOME RECENT STUDIES, INVOLVING THE USE OF RADIOISOTOPES, OF THE FEEDING BEHAVIOUR OF TWO PHYTOPHAGOUS INSECTS. C. J. Banks (Rothamsted Experimental Station, Harpenden, Eng.). p.175-9 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

Three examples of researches made on insect pests with radioisotopes are given. The feeding and excretion rates of Aphis fabae Scop. were estimated by allowing the insects to feed on bean leaves made radioactive with P^{32}, and then relating the radioactivity of the aphids to that of the leaves. The results are presented and the method critized. By allowing groups of A. fabae to feed on bean plants made radioactive with P^{32}, the hypothesis that ant-attendance significantly increases the aphid's feeding and excretion rates was confirmed. The movements and feeding behavior in the field of adult Senn bugs (Eurygaster integriceps, Put.) were studied in Iran by tagging individual insects with small pieces of Ta^{182} so that they could be detected from a distance with a suitable instrument. The results are described. (auth)

16122 STUDIES ON THE ASSIMILATION AND EXCRETION OF LABELLED PHOSPHATE IN APHIDS. W. Kloft and P. Ehrhardt (Universität, Würzburg, Ger.). p.181-90 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

Measurements show that aphids take up food only some time after stinging, at a moment which corresponds with reaching the phloem. The activity then suddenly increases to an approximate maximum, which is reached after the intestinal tract has become full of labeled phloem sap. Subsequently, however, the activity increases slowly because of resorption from the midgut. In the meantime, incorporation (assimilation) and excretion of radioactive material begins in different ways. The interval between the uptake of the tracer from a plant to its re-excretion with the saliva is 5 hr at a temperature of 22–24°C. This period, as well as the exact course of excretion of saliva during sucking and the distribution of saliva in the plant itself, were analyzed in detail. Tracer experiments indicate how the problem of virus transmission (especially of persistent ones) by plant-sucking insects may be attacked. Further excretion of the radioisotope takes place in the honeydew as well as through the bearing of larvae. On hatching, these larvae have only a low activity but this increases after longer periods of resorption in the maternal organism. On account of continuing ovoviviparie and by the use of P^{32} it was possible to obtain a record of the phosphate metabolism of the ovary in the live aphid. By measuring the different kinds of excretion as well as the remaining activity, the biological half-life and the amount of tracer actually assimilated may be determined. Any circulating radioactivity may be detected by measuring the hemolymph. Constant temperature must be ensured since the processes are highly sensitive to changes in temperature. (auth)

16123 EFFECT OF RADIATION ON MEXICAN FRUIT-FLY EGGS AND LARVAE IN GRAPEFRUIT. L. E. Brownell and M. Yudelovitch (Univ. of Michigan, Ann Arbor). p.193-206 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

A limited study was made of the effect of gamma radiation from cobalt-60 on the eggs and larvae of the Mexican fruit-fly. Various doses from 5000 to 90,000 rad were given to fruits one and twelve days after infestation to explore the effects of irradiation on the egg and first-instar larval stage. Fruits containing fully grown larvae and larvae at intermediate stages were also irradiated with similar doses. Frequent examination and dissection of the fruits were used to determine larva mortality, larval damage to fruits, presence of pupae, and presence of adult flies. Dissected fruits given radiation doses of 5000 rad or more during the egg or first-instar larval stage showed no presence of insects and no trace of insect damage. Fruit infested with adult larvae produced numerous pupal recoveries but no adult flies emerged from pupae recovered from fruits receiving a radiation dose of 5000 rad or more. It is concluded that a gamma-radiation dose of 5000 rad (and possibly less, based on limited tests of 2000 rad) will break the life cycle of the Mexican fruit-fly although the larval stage may survive appreciably greater dosages. A design for a railway mobile gamma-irradiator for treating infested fruit is proposed. (auth)

16124 PRELIMINARY STUDIES ON THE EFFECTS OF GAMMA-RADIATION ON HOUSEFLY PUPAE WITH SPECIAL REFERENCE TO THE CRITICAL PERIODS IN RELATION TO THE MECHANISM OF EMERGENCE. K. K. Nair (Atomic Energy Establishment, Trombay, India). p.207-11 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

Studies on the radiation sensitivity of housefly pupae in different stages of development have been carried out with special reference to the mechanism of emergence. The different dose levels employed were 500, 1000, 2000, 2500, 5000, and 10,000 r. The data obtained on percentage emergence in each group indicated that the early stages of development were most sensitive to radiation, since a dose of 2000 r and above applied to 5-hr-old pupae resulted in no emergence at all, while the same doses applied to 30–80-hr-old pupae did not appreciably affect the mechanism of emergence in these groups. Development in the 2–5-hr-old irradiated pupae was found to be complete, but the flies failed to emerge. The significance of the findings is discussed. (auth)

16125 THE EFFECTS OF CONTINUOUS AND FRACTIONATED DOSES OF GAMMA-RADIATION ON THE SURVIVAL AND FERTILITY OF SITOPHILUS GRANARIUS (CALANDRA GRANARIA L.). D. J. Jeffries (Atomic Energy Research Establishment, Wantage, Berks, Eng.). p.213-31 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

An investigation was made into the effect of dose fractionation on the radiation susceptibility of eggs, larvae, pupae, and adults of the grain weevil. Survival of all developmental stages was significantly increased by fractionation, particularly with larvae and pupae. The difference in survival afforded by continuous and fractionated treatments must be attributed to recovery during the intervals between damage. Recovery was noted with intervals of 10 min and longer, the amount of recovery and final survival being governed by the number of fractions, fractional dose, interval time, and interval temperature, but not by over-all dose rate. Rate of recovery was greatest in the first few hours after irradiation, and decreased with increasing number of fractions. Irradiation is followed by a period of reduced sensitivity to subsequent treatment. Recovery was obtained in the reproductive capacity of irradiated eggs, larvae, and pupae, but not adults. Adults subjected to fractionated treatment did not redevelop fertility in later months. Pupae showed the highest capacity for recovery of somatic and reproductive cells. Adults require the highest dose to kill and sterilize by continuous and fractionated treatment and are potentially the most dangerous state in the event of inefficient control. While these effects are manifest at low doses, fractionated treatment does not adversely affect the degree of control achieved at the commercial dose level. (P.C.H.)

16126 THE USE OF RADIATION SOURCES FOR INSECT CONTROL. T. Horne (Curtiss-Wright Corp., Princeton, N. J.) and L. E. Brownell. p.233-54 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

Different radioisotopes and electrical machine sources of radiation are briefly discussed, but a greater emphasis is placed on radioisotopes because of their greater reliability and ease of operation. The numbers of curies of the most suitable isotopes for various applications are tabulated. The general principles of source design covering radiation flux intensity, optimum dose distribution, and shielding requirements are outlined. Various procedures for the use of radiation in control of insect populations are reviewed, including the sterile-male release technique, direct irradiation of agricultural products, the combined use of insecticides with irradiation, and the possible use of radiation as an insect repellent. Possible new applications such as the combined use of insecticide and sterile-male release in a program for the eradication of the malarial mosquito in the Indonesian islands are suggested. A new method is put forward for storing grain for a long time without the need for periodic fumigation. This method involves the use of a special grain container and radiation processing. Designs for various irradiators and some of the problems encountered are reviewed. Special reference is made to small semi-portable irradiators suitable for insect sterilization; to a flexible laboratory irradiation unit covering both research and field scale applications; and to some of the large production scale facilities proposed for commercial use. (auth)

16127 RESEARCH ON RADIATION IN INSECT CONTROL. D. E. Weidhaas, C. H. Schmidt, and W. F. Chamberlain (U. S. Dept. of Agriculture, Orlando, Fla.). p.257-65 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

A summary of the development and application of the sterile-male release technique, in which gamma radiation was used as the sterilant, in the eradication of the screwworm, Callitroga hominivorax (Cqrl.), is presented. Preliminary laboratory and field results on the application of this same technique to the control or eradication of mosquitoes, Anopheles quadrimaculatus (Say), and fruit-flies, (Mediterranean), Ceratitis capitata (Weid.), the oriental fruit-fly, Dacus dorsalis, (Hendel) and the melon fly, Dacus curcurbitae (Coq.) are presented. Results are also given showing the lethal effects of radiation on some insects of medical importance, including the body louse (*Pediculus humanus humanus* L.), housefly (*Musca domestica* L.), American cockroach (*Periplaneta americana* (L.)), German cockroach (*Blattella germanica* (L.)), firebrat (*Thermobia domestica* (Pack.)), bed bug (*Cimex lectularius* L.), and the Pharaoh ant (*Monomorium pharaonis* (L.)). (auth)

16128 CONTROL OTHER THAN BY INSECTICIDES. R. Delattre (Institut de Recherches du Coton et des Textiles Exotiques, Paris). p.267-71 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In French)

Discussion is given on the feasibility of applying radiation control to the Dysdercus problem in tropical countries. It is felt that the radiation effects could be propagated by suitably attracting the populations as a result of their own movements. The results, if successful, would be of considerable economic value. (P.C.H.)

16129 ON THE ROLE OF LETHAL MUTANTS IN THE CONTROL OF POPULATIONS. R. C. von Borstel (Oak Ridge National Lab., Tenn.) and A. A. Buzzati-Traverso. p.273-8 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

Since radiation induces dominant lethal mutations in sperm, it can be shown that monogamy is not requisite for eradicating a population through the introduction of irradiated males. An outline is presented for experimental analysis of population collapse by the irradiation-of-male method where females mate more than once. Possible effects on populations of release of males containing recessive lethal mutations or mutations for female sterility are briefly discussed, the possibility of genetic induction of population extinction is explored. (P.C.H.)

16130 THE SCOPE OF THE USE OF RADIOISOTOPES AND RADIATION SOURCES IN ENTOMOLOGY IN PAKISTAN. H. A. Qayyum (Punjab Agricultural Coll., Lyallpur, Pakistan). p.281-5 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

The application of radioisotopes and radiation sources in entomological research in Pakistan is discussed. It is believed that such research would be practical and of potential productive interest since it may ultimately contribute toward a saving of millions of rupees by eradicating certain crop pests. The problems which deserve to be investigated by entomologists in Pakistan with the help of radioisotopes include a study of the migratory habits of insects such as *Sylepta derogata* F., *Apis dorsata* F., and *Apis indica* F. (P.C.H.)

16131 THE FUTURE OF RADIOISOTOPES IN INSECT-CONTROL INVESTIGATIONS IN THE PHILIPPINES. G. B. Viado (Philippine Atomic Energy Commission, Manila). p.287-95 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In English)

Insect pests of the major and some of the minor crops and the extent of damage they cause in the Philippines are reviewed in order to allow a better appreciation of the need for effective control measures so as to prevent or at least reduce to the minimum their ravages, and thereby increase production. It is hoped that with the use of radioisotopes a better understanding of the pests in the Philippines will be reached so that more effective control measures may be formulated. (P.C.H.)

16132 APPLIED ENTOMOLOGY RESEARCH USING ISOTOPES AND NUCLEAR RADIATIONS IN FRANCE AND THE ASSOCIATED COUNTRIES. P. Pesson (Institut National Agronomique, Paris). p.297-300 of "Radioisotopes and Radiation in Entomology." Vienna, International Atomic Energy Agency, 1962. (In French)

Work done or being done in Upper Volta at Bures-sur-Yvette and at Bondy, using radioisotopes for labeling sandflies and ants, *Apis mellifica* and *Aphis leguminosae*, and research projects in tropical regions, in tropical Africa and in France in connection with the labeling of *Perkinsiella*, *Trichogramma*, *Locusta migratoria*, and certain mosquitoes or their predators is given, along with research on the sterilization of insects (*Apis mellifica*, *Ephestia kuhniella*, *Calandra granaria*, *C. oryzae*, *Trogoderma*, *Acanthoscelides obtectus*, *Rhizophertha*, *Gnathocerus*, *Tenebrio*, and *Sitotroga cerealella*) and the cytological effects of radiations on the gonads of *Calandra granaria*. (auth)

16133 WHOLE-BODY COUNTING. Proceedings of the Symposium on Whole-Body Counting held at Vienna, 12-16 June 1961. (International Atomic Energy Agency, Vienna). Proceedings Series. Jan. 1962. 543p. (STI/PUB/47). $10.00(IAEA).

Separate abstracts were prepared for 30 papers presented at this symposium. (C.H.)

16134 WHOLE-BODY COUNTING: AN INTRODUCTORY REVIEW. F. W. Spiers (Univ. of Leeds, Eng.). p.3-12 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

Consideration is given to the reasons which have made it essential, in recent years, to develop methods of measuring the natural radioactivity of the body and of detecting the smallest possible increase that may occur from occupational or other causes. The earliest measurements of comparatively large body burdens of radium are briefly reviewed to illustrate the conditions which must be satisfied for the high sensitivity now required. The development of ionization chamber, Geiger-Müller counter, and scintillator equipment are discussed, to give a general picture of the capabilities of present apparatus. The origin of the background response of whole-body monitors and the need for calibration methods are considered and related generally to the problems to which the apparatus can be applied. The types of investigation which can be made with whole-body counters are briefly reviewed and the advantages and limitations of the method are examined. (auth)

16135 SODIUM IODIDE SYSTEMS: OPTIMUM CRYSTAL DIMENSIONS AND ORIGIN OF BACKGROUND. Harold A. May and Leonidas D. Marinelli (Argonne National Lab., Ill.). p.15-36 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

The relatively high probability of gamma-ray interaction in sodium iodide and its excellent spectrometric properties are factors recommending its use in low-level *in vivo* counting. To obtain maximum sensitivity consistent with economy, consideration must be given to the most efficient choice of crystal dimensions and to reduction of the background counting-rate. In order to gain some information on the economical utilization of crystal mass, a pilot study has been made for the case of point sources at distances of 40 cm. The method utilizes the photopeak fractions calculated by Miller and Snow for crystals of various sizes and gamma rays of various energies. Results indicate an optimum thickness of about 2.5 cm at 300 kev, 5.0 cm at 700 kev, and 10 cm from 1.5 to 3.0 Mev. Experimental results with the non-ideal sources and detectors employed in actual practice are discussed. As to background in NaI crystal, studies have been in progress at this Laboratory since 1950 and early results were published in 1956. Since then, more extensive and precise data have been gathered, aided greatly by the availability of the large crystals and improved electronic instruments which are necessary for whole-body counting. The experiments described indicate that, in a typical crystal and shield, the major sources of background pulses within the energy range 25 kev to 1.6 Mev are as follows: shielding materials, 35 to 40% of total background; cosmic rays, 24 to 28% of total background; and phototubes, 16 to 20% of total background. The interpretation of coincidence pulse spectra extending to over 50 Mev, obtained with plastic scintillator and GM-tube anticoincidence shields in many different configurations, has been greatly aided by comparison with similar spectra obtained with the same equipment located 76 m underground. Typical spectra are discussed. In conjunction with current theories of deep penetration of gamma rays, a survey of the experimental performance of thick shields of materials of different atomic number has clarified the role played by the shield and suggested the feasibility of measuring very low specific gamma-ray activities of matter in bulk. (auth)

16136 HUMAN COUNTERS USING LIQUID SCINTILLATORS. M. A. Van Dilla and E. C. Anderson (Los Alamos Scientific Lab., N. Mex.). p.41-58 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

Performance characteristics of three whole-body liquid scintillators were studied and Monte Carlo machine calculations of energy-deposition spectra applied to the theory and optimum design of such detectors. The latest counter (Humco II) is a 4π system with 12-in. liquid thickness and 24% photocathode coverage. The extensive photocathode coverage increased light collection, permitting measurement of weak (about 100-kev) gamma rays and bremsstrahlung from beta-ray emitters. Improved energy resolution permits 7-channel operation, making multiple tracer studies and analysis of simple mixtures feasible. An increase in scintillator thickness has improved detection efficiency (56% for Cs^{137}), increased multiple scattering and made sum peaks comparable with single peaks. The spectral shape of Cs^{137} shows an asymmetric peak rising by a factor of 2 above the continuum. The use of a nonvolatile solvent has eliminated the inherent fire hazard. An IBM-704 code (Zerby and Moran, Oak Ridge National Laboratory) was used to calculate energy-deposition spectra in liquid scintillators as a function of scintillator and source geometry, source energy and Gaussian broadening to match energy resolution. Computations of the Cs^{137} spectrum for very small scintillators give results very close to the Klein-Nishina predictions for single scatter. Computations for a larger, 40-1 cylindrical scintillator show a double peak at energies equal to maximum Compton single- and double-scatter values (0.47 and 0.58 Mev). Computations for Humco II (1600 l) show a single asymmetric peak made up of the sum of a multiple scatter, and a full energy-absorption peak at 0.62 and 0.66 Mev respectively. Thus, multiple scattering has a complicated effect on spectral shape as size increases. Considering cost, the optimum design for general biomedical purposes (including tracer metabolic studies, clinical investigations, natural K^{40} measurements, and large-scale personnel monitoring) is a 2π liquid scintillator of the type now in operation at Landstuhl, Federal Republic of Germany. These detectors are being used at the Los Alamos Scientific Laboratory to study inter-species correlations in radioisotope metabolism, radioisotope applications in clinical and diagnostic medicine, detection of personnel exposure, Cs^{137} levels in people and milk, and natural K^{40} levels in relation to gross body composition. (auth)

16137 THE CONSTRUCTION AND PERFORMANCE OF A THREE-UNIT PLASTIC SCINTILLATOR WHOLE-BODY COUNTER. P. R. J. Burch, D. Hughes, T. A. Iinuma, T. R. Overton, and D. B. Appleby (Univ. of Leeds, Eng.). p.59-69 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

A description is given of the construction, the counting statistics, and the γ-ray spectral characteristics of a three-unit plastic scintillator whole-body counter. Each unit consists of a plastic block (20 in. long, 10 in. wide and 6.5 in. thick) the ends of which are hemicylindrical. Scintillations in each unit are viewed by two 7-in.-diameter photomultipliers mounted concentric with the hemicylinders. Two units are placed behind and close to the back of the seated subject, their long axes being parallel to the spine. The third unit, the position of which is adjustable, is placed opposite the chest with its long axis horizontal. The whole assembly is contained within a lead-lined steel cubicle, ventilated by filtered air, in the sub-basement of a hospital block. The laboratory has a 30-in. thick concrete ceiling and is well shielded from the intense sources of x- and γ-radiations used in neighboring parts of the hospital. The photomultiplier output signals taken from cathode followers on the three units are mixed and then passed to a non-overloading pulse-amplifier of the Fairstein type. In routine use, the amplifier output is analyzed by several (usually six) single-channel analyzers. Typically, the count-rate in the potassium region of the spectrum from 150 g potassium in the body is a little over 20 counts/s; the background in the same region is between 20 and 30 counts/s. Consequently, the standard error of the counting statistics in a body-potassium determination of 15 min duration is just over ±1%. Spectra from various representative γ-emitters (obtained with a multi-channel analyzer) are illustrated. (auth)

16138 AN EXPERIMENTAL EVALUATION OF MULTIPLE-CRYSTAL ARRAYS AND SINGLE-CRYSTAL TECHNIQUES. C. E. Miller (Argonne National Lab., Ill.). p.81-120 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

This study was undertaken to ascertain the sensitivity of various geometries in human body counters and to evaluate the uncertainties arising in each case from the use of an average calibration factor in people of the same height and weight, but differing in other anatomical characteristics. The following measuring techniques were used with a single crystal: the 175-cm-arc technique, the "Tilting Chair" technique, the crystal at the small of the back, and a crystal under the chair of a seated person. In addition, various multiple-crystal arrays were evaluated by placing in turn, a single crystal at 7 equally spaced points 10-in. apart along the body, at each of two heights above and two distances below the supine subject. The gamma-ray spectra of a group of 20 patients, containing known quantities of K^{42}, and a group of 12 patients, containing Ra^{226}, were obtained. The counting-rate from each subject, corrected for excretion and decay in the case of K^{42}, was compared with the average for the group to determine the magnitude of the variations that existed between subjects of different body builds. To evaluate further the calibration problems involved in each array the subject's spectra were compared with the spectra obtained with known amounts of the same isotope in various phantoms. Although with a multiple-crystal array greater sensitivities are possible than with the tilting chair, the uncertainty involved is about twice that obtained with the tilting chair or the 175-cm arc. This uncertainty can be eliminated by administering to each person a known tracer dose; however, this may not always be feasible and should be avoided, since it increases considerably the technical difficulties. (auth)

16139 SOME CALIBRATION PROBLEMS OF WHOLE-BODY GAMMA-RAY SPECTROMETERS. J. Rundo (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.121-37 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

The various methods of calibrating whole-body gamma-ray spectrometers and the problems each involves are discussed. The methods considered include administration of a known amount of the radio-nuclide concerned, estimation of the amount of activity excreted over a period and determination of the net response from this amount by the difference between measurements at the beginning and end of the period, measurements in the 1-m-arc position, either with matching of the gamma-ray spectrum from a phantom or by mathematical analysis, and a simple empirical method used at Harwell. The K^{40} activity can be used as an internal standard for approximate estimates of the level of contaminants. It is shown that some care is needed in metabolic studies where the response from the amount administered may be used as a reference, as changes in the distribution of the activity *in vivo* can change the gamma-ray spectrum. Methods of calibration for potassium and Cs^{137} are discussed in some detail, and a comparison is made of the results of measurements on several individuals at four laboratories. The problems of calibrating for the bremsstrahlung emitted by pure beta-particle emitters are considered briefly. (auth)

16140 LOW-ENERGY-PHOTON DETECTORS FOR WHOLE-BODY COUNTING. Kurt V. H. Lidén and Richard C. McCall (Univ. of Lund, Sweden). p.145-66 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

The special problems involved in measuring low-energy-photon emitters *in vivo* are discussed. The significant aspects of the interaction of low-energy photons with tissue and with various types of detectors are surveyed. Methods of background reduction are briefly mentioned. The characteristics of the thin NaI(Tl) scintillation counters used in this experiment are described. The characteristics of this detector for measuring bremsstrahlung from pure beta-emitters *in vivo* are compared with those of a conventional thick NaI(Tl) scintillation counter. Measurements of both detectors on Y^{90} in phantoms and in humans are described. An attempt has been made to calculate the minimum detectable amount for each detector. Possibilities for future work are discussed. (auth)

16141 PERFORMANCE AND RESULTS OBTAINED WITH THE CEA GAMMA SPECTROGRAPH IN DETERMINING RADIOACTIVITY IN THE HUMAN BODY. A. Lansiart (Centre d'Études Nucléaires, Saclay, France). p.171-88 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In French)

During the past four years, the Commissariat à l'énergie atomique has constructed, for its health services, some ten gamma spectrometer facilities for determining radioactivity in the human body. Half are in use, the others are being delivered to users. Only one detector type is in use, the large NaI(Tl) crystal. There are three types of shield, two for a stationary laboratory facility and one for a mobile facility mounted on a trailer. The mobile facility and one of the stationary facilities take the form of a tunnel with lead walls 5 to 10 cm thick and retractable collimation plugs, the total weight being approximately 8 t. The subject is examined lying down or seated. The third type consists of an iron chamber, 20 cm thick. The electronic equipment was developed as new pulse-height selectors became available. The choice is determined by price, time loss and ease of repair. The following factors are considered: clarity of definition of the spectrum observed, quality and ease of use of the environmental radiation shielding, calibration, and presentation of measurement results. In four years, the resolution measurement with a cesium-137 source improved Cs^{137} from 18% to 9%; with a single photomultiplier having a 110 mm photocathode, 12% was obtained. Three photomultipliers give the best performance. The choice of shielding against external radiation was guided by background fluctuations recorded for a standard facility at Saclay. In view of the counts of argon-41 coming from the reactors and contained inside the shielded enclosure, the possibility of, in certain cases, feeding aged air into the enclosure has been considered. Various read-out systems in pulse-height selectors available on the French market and proposed improvements are also discussed. (auth)

16142 THE ADVANTAGES OF MEASURING WITH TWO OPPOSED DETECTORS WHEN STUDYING THE DISTRIBUTION OF A RADIOISOTOPE IN THE SYSTEM. Ivo Baschieri (Università, Rome). p.203-9 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In French)

The study of the distribution of radioisotopes in the body, either by point-by-point scanning or by using automatic scanning techniques, raises certain problems. The absorption of gamma radiation by the tissues, which makes it difficult to detect the presence of radioactive regions situated in depth, must primarily be borne in mind. With a view to reducing the effects of absorption, research with two opposing detectors was carried out. The results of the first experiments, which are presented, demonstrate the advantages of the technique. (auth)

16143 THE WHOLE-BODY COUNTERS AT THE JAPANESE NATIONAL INSTITUTE OF RADIOLOGICAL SCIENCES. H. Eto, H. Watanabe, E. Tanaka, and T. Hiramoto (National Inst. of Radiological Sciences, Chiba, Japan). p.211-18 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

Two kinds of whole-body counter are now under construction and are expected to be completed in 1961. The NaI scintillator system uses two sets of NaI crystals, 8 in. dia. × 4 in., placed over and under the horizontal bed in the iron room. The measuring apparatus is so arranged that the 1-m-arc method, the standard-chair method, and also the scanning method will be practicable. Coincidence operation between the two detectors is possible and a 256-channel pulse-height analyzer is used. The plastic scintillator system uses two sets of detectors, each consisting of four plastic scintillators 50 × 50 × 15 cm, placed parallel to the floor in another iron room. Four 5-in.-dia. photomultiplier tubes are used for each plastic scintillator. Persons to be examined are laid on the bed outside the iron room and then wheeled in between the detectors. The results of the measurements are analyzed with a two-channel pulse-height analyzer. (auth)

16144 AN "OPEN-BOOTH" BODY COUNTER. Bo Lindell (Inst. of Radiophysics, Stockholm). p.235-51 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

A body counter is described which has been in use at the Institute of Radiophysics, Stockholm, since October 1958.

The installation is of an unconventional type with an open booth of iron, providing effective shielding through its floor, roof, and three walls, but open in one direction. The crystal is mounted on a carriage, which can be moved in front of the opening, and is surrounded by lead except in the direction of the object to be measured in the iron booth. Through this construction a total weight of only 6.5 t provides the same effective shielding as a complete iron room for energies above 0.5 Mev, where the scattered radiation gives a negligible increase. Quantitative measurements on humans cannot easily be done because of the fixed short-distance geometry, but the equipment is very convenient for qualitative measurements, with a sensitivity as good as that of any arrangement with complete shielding. For elements which are uniformly distributed within the body, measurements relative to K^{40} permit quantitative assessments in terms of, e.g., the Cs^{137}/K ratio. The usefulness of the apparatus is illustrated by a number of applications. (auth)

16145 THE WHOLE-BODY COUNTER AT TROMBAY. A. S. Chhabra and R. K. Hukkoo (Atomic Energy Establishment, Trombay, India). p.253-61 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

The human body acquires radioactive elements from the environment and as a result of medical or occupational exposure. The radioactivity present in the environment may be natural or man-made, the latter in turn being due either to nuclear weapon tests, radioactive waste disposal or routine or accidental release of radioactive materials. The measurement of internal contamination of human beings is done by bio-assay techniques and in the case of gamma- and high-energy beta-emitters these are supplemented by whole-body counting methods. When NaI(Tl) crystal scintillation detectors are used for in vivo counting, they provide a high degree of accuracy and energy discrimination for the identification of isotopes. An 8-in. dia. × 4-in. thick crystal specially canned in stainless steel having a quartz window and coupled to three 3-in. photomultipliers is used. The analysis of the pulses is carried out with a 30-channel pulse-height analyser of the Gatti type. The reduction of the background is achieved by having the detector enclosed in an 8-ft × 6-ft × 6-ft steel room, the walls of which are made up of 32 mild-steel plates each $\frac{1}{4}$-in. thick. A $\frac{1}{8}$-in. lining of radioactively clean lead is provided on the inside to reduce the contribution from the activity of the mild steel to the background. The facility will be used to measure the body burdens for K^{40}, Ra, Cs^{137} and other gamma-emitting isotopes. Localization of body radioactivity and evaluation of turnover and clearance rates of isotopes are further tasks planned for the counter. The latter information will be very useful in arriving at MPC values for the isotopes. The estimation of Sr^{90} and other beta-emitters by measurement of bremsstrahlung radiation is also being planned. (auth)

16146 MEASUREMENT OF RADIUM AND THORIUM BURDENS. H. Muth and E. Oberhausen (Universität, Saar, Homberg, Ger. and U. S. Medical Research Unit, Landstuhl, Ger.). p.267-75 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

In 1960, in order to collect data for the estimation of internal radiation doses, the Biophysics Institute of the University of the Saar and the United States Medical Research Unit, Landstuhl, started joint research on the measurement with radium and thorium (thorotrast) deposits in human beings. Total body burdens were estimated with the help of a 2π scintillation counter. Results of measurements are reported for 21 persons. The activity of the deposits was in the range of 3×10^{-7} to 5×10^{-9}c for persons with Ra^{226} or Ra^{228} deposits, and in the range of 12×10^{-7} to 2×10^{-7}c Ra^{228} for thorotrast patients. In addition to whole-body measurements, thoron and radon concentrations in expired air were also measured. Samples of blood, urine and faeces were analyzed for the different daughter products. These data are fundamental in estimating the internal radiation dose both for the different organs and for the whole body. (auth)

16147 RETENTION OF RADIUM IN HUMANS FROM 20 TO 29 YEARS AFTER INTRAVENOUS ADMINISTRATION. Charles E. Miller and Leonidas D. Marinelli (Argonne National Lab., Ill.). p.279-84 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

The retention of radium in humans from 20 years to 29 years after intravenous injection was determined by measuring the radium body content of a group of mental patients who received from 70 to 410 μc at the rate of 10 μc per week in 1931. Their body contents were measured in 1931, 1951, 1953, and 1959 and 1960 with whole-body gamma-ray measuring techniques that ranged from the use of a sensitive electroscope in ordinary rooms to that of a suitably calibrated and shielded low-level crystal spectrometer. Within experimental error, the data obtained show that the retention of intravenously injected radium between the 21st and the 29th year can be described by the power law enunciated by Norris et al., with the exponent calculated for the first 21 years after administration. (auth)

16148 DETERMINATION OF PLUTONIUM-239 BODY BURDEN USING GAMMA SPECTROMETRY WITH PROPORTIONAL COUNTERS. H. Kiefer and R. Maushart (Kernforschungszentrum, Karlsruhe, Ger.). p.289-93 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

The construction of a part-body monitor consisting of eight large-area proportional counters is described. Four of them are operated as anticoincidence shields. The assembly has almost 4π geometry for samples of up to 40 cm in length and 11 cm in diameter. For in vivo measurements the subject places his arm into the counter, while for urine analysis the liquid is measured without concentration in special plastic bottles. In consequence of the energy selection with a single- or multi-channel analyzer, a very good discrimination factor against the radiation of other isotopes is attained. (auth)

16149 THE USE OF A WHOLE-BODY COUNTER FOR DETERMINING PULMONARY DEPOSITION AND CLEARANCE OF INHALED PARTICLES IN MAN. Roy E. Albert and Bernard Altshuler (New York Univ., New York). p.299-306 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

Whole-body counting techniques provide the most direct and practical means of measuring the intrapulmonary deposition and clearance of insoluble dust in the lungs of man. The work to be reported here is an outgrowth of an earlier investigation using radioactive iron dust in man, which showed that the external counting of deposited activity in the lungs from gamma-emitting dust describes at least two phases of lung clearance and that these phases characterize sites of intrapulmonary deposition in the physiological sense of whether the inhaled dust lands on the ciliated portion of the bronchial mucosa (associated with fast clearance) or in the alveoli (associated with slow clearance). The development of low-level gamma spectroscopy for human usage has made possible a considerable extension and refinement of the earlier physiological studies of particle clearance from the lung, for both normal and disease states. It allows the simultaneous measurement of several different classes of particles, each tagged with a different gamma-emitting isotope. Initial results are presented from a current study involving the simultaneous administration to normal adults of five tagged dusts ranging in median size from $^3/_4$ to 9 μm. Details of technique will be discussed, including selection of suitable isotopes, preparation and administration of radioactive dusts, calibration methods and data processing. (auth)

16150 PRACTICAL USES OF A GAMMA SPECTROMETER FOR MEASURING RADIOACTIVITY IN THE HUMAN BODY. L. Jeanmaire and H. Jammet (Commissariat à l'Énergie Atomique, [Paris]). p.321-8 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In French)

The CENFAR Nuclear Health and Radiopathology Service gamma spectrometers for investigating radioactivity in the human body are used for general radioactivity monitoring of a population subject to natural or artificial contamination, routine monitoring of personnel employed in a nuclear center, and measurements of natural radioactivity. (auth)

16151 THE MEASUREMENT OF TOTAL BODY POTASSIUM IN MAN AND ITS RELATION TO GROSS BODY COMPOSITION. Alexander P. Remenchik (Veterans Administration Hospital, Hines, Ill.) and Charles E. Miller. p.331-9 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

Total-body potassium of a group of hospitalized subjects was estimated by the measurment of K^{40} activity of the body and by the measurement of total exchangeable potassium. Lean body mass and total fat content were calculated from the measurement of tritiated water space. The gross body content of potassium (from K^{42}) of 29 subjects is 1.72 ± 0.05 g/kg and (from K^{40}) of 28 subjects is 1.87 ± 0.07 g/kg. The lean body mass content of potassium (from K^{42}) of 23 subjects is 2.18 ± 0.04 g/kg and (from K^{40}) is 2.32 ± 0.04 g/kg. In four obese subjects the lean body mass content of potassium (from K^{40}) is 2.15 ± 0.04 g/kg. The mean K^{42}_B/K^{40}_B of 24 patients is 92.3 ± 1.2%. In six patients whose total body potassium was depleted by antihypertensive therapy the mean K^{42}_B/K^{40}_B decreased to 87.6 ± 1.7%. The mean K^{42}_B/K^{40}_B of four obese subjects is 101.6 ± 0.9%. The problems of estimation of total-body potassium are discussed. (auth)

16152 THE EFFECT OF POTASSIUM INTAKE ON EXCRETION OF Cs^{137} IN THE HUMAN. K. G. McNeill, R. M. Green, and A. Rapoport (Univ. of Toronto). p.357-9 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

Tests were made on the possible effects of increased potassium intake on the metabolism of Cs^{137} by the human body. Two persons with no significant history of radioactive contamination and who otherwise maintained a normal diet containing approximately 3 g of potassium per day were, over a period of a month, given an additional 2.6 g per day. Collections of urine were made and 72-h samples counted for Cs^{137} and K^{40} content with a 5-in. NaI crystal. The extra potassium intake was not found to have any major long-term effect on the excretion of Cs^{137}. The experimental results obtained before, during, and after the month of extra potassium are presented and commented upon. (auth)

16153 THE USE OF MAGNETIC-TAPE LOOPS FOR STORAGE AND EVALUATION OF GAMMA-RAY SPECTRA. T. R. Folsom and R. A. Cramer (Scripps Institution of Oceanography, La Jolla, Calif.). p.367-74 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

For over two years an effective system for processing gamma-ray spectrograms with the aid of magnetic tape has been used in connection with low-level non-destructive gamma assays. Information collected in digital form in the memory of a standard multi-channel pulse-height analyzer is transferred onto loops of ordinary magnetic tape that are easily filed. The information stored on any loop may be returned later and within a few seconds to the memory, moreover it may be returned in any predetermined numerical magnitude. Further, this incoming information may be added to or subtracted from what already is present in the static magnetic storage memory. The information is transferred and stored in digital form, and the original numerical accuracy is therefore maintained. Thus, the spectrum resulting from exposure from a complex geometry such as is presented by a whole body, or other large biological specimen containing several activities, can be accurately filed. It may then be compared, perhaps weeks later, with the results of another experiment with a similar body or with a phantom containing known activities. Because digital division and multiplication can be done immediately and rapidly upon every number, every spectrum can be adjusted for proper comparison without regard to the experimental exposure times. Further, the whole spectrum of one gamma isotope whose effects previously have been measured and stored can be stripped from any other spectrum. The new accessory digital equipment permitting these functions was developed at this Institution and has been licensed by the University for commercial reproduction. (auth)

16154 THE USE OF COMPUTERS IN WHOLE-BODY-COUNTER DATA PROCESSING. George R. Meneely, Howard L. Rolf, Raymond L. Weiland, Robert M. Heyssel, and Robert T. Lagemann (Vanderbilt Univ., Nashville). p.379-87 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

Adequate exploitation of the capabilities of a whole-body gamma-ray spectrometer requires fast data-processing for the integration of photopeak areas in multiple channels, evaluation of counting error by application of Poisson statistics, conversion to coefficients of variation, reduction of noise by smoothing processes, such as fitting a cubic function to five or seven adjacent spectral points by least-square methods, and normalizing spectra for time, for kev per channel and for zero shift. Normalizing may take account of crystal efficiencies at different gamma-ray energies. Machine methods can be used for spectral stripping by calculation of Compton distributions associated with given photopeaks. This may involve interpolation between experimentally determined Compton distributions above and below the new energy. Conversion factors may be calculated taking account of the stature and habitus of the subject as regards both solid angle and self-absorption of subjects of different thickness. Output data may be reduced to useful form, reorganized in a manner suitable for machine tabulation and may be examined by internal and external correlation by sorting or other machine methods. Sophisticated calculations may tax the storage facilities of all but the more elaborate electronic computers. A judicious combination of human and machine processes proves most efficient. (auth)

16155 CLINICAL WHOLE-BODY COUNTING WITH SIMPLE DETECTION SYSTEMS. N. Veall (Guy's Hospital, London). p.397-405 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

The most important practical advantage of the whole-body counting technique in clinical work is that it permits precise measurements to be carried out with ease and convenience on the rate of loss of the tracer element from the body under circumstances where it is difficult to achieve reliable collection of excreta. On the comparatively rare occasions when such collections are possible, comparison of the data obtained for urine and faecal excretion with the results of whole-body counter measurements enable estimates to be made of losses by other routes, particularly via sweat, since the whole-body measurements relate to the total loss by all routes. Another important practical advantage of the method is that it enables studies to be carried out on normal subjects or hospital out-patients without the necessity of subjecting them to the somewhat artificial and possibly unphysiological conditions of a metabolic unit. If one is only concerned with excretion rates, the administered dose can be reduced and the duration of the study can be extended if whole-body counting apparatus of high sensitivity is used. However, in the majority of applications, particularly if the body pool size is varying, it is desirable to carry out specific activity measurements on samples such as blood, plasma, urine, etc. These would normally be carried out with a well-type scintillation counter and it is the counting-rate obtained from such samples which usually determines the dose to be administered. Under these conditions, a simple whole-body counter based on G. M. tubes is usually adequate from the point of view of sensitivity; in fact, it is sometimes necessary to restrict the sensitivity to avoid difficulties due to dead-time limitations at high count-rates. For the same reason it is rarely necessary to go to a great deal of trouble to reduce the background count of the apparatus. Simple G. M.-tube assemblies can be made with very little capital expenditure and the arrangement can be varied considerably to meet particular clinical requirements. The whole-body counting technique is most effective when the radioactive half-life of the isotope is long and the period required to achieve effective geometrical (as distinct from physiological) equilibrium in the body is short compared with the biological half-life of the material under study. The isotope should also have a high specific gamma-ray emission. Most of the isotopes or compounds which have been used to date fail to meet all of these requirements. Na^{22}, however, appears to be an ideal isotope in all respects, and it has already been used in a variety of clinical studies. (auth)

16156 USE OF A CLINICAL BODY COUNTER FOR LONG-TERM EXCHANGEABLE SODIUM STUDIES. Gerald J. Hine, Paul I. Jagger, and Belton A. Burrows (Veterans Administration Hospital, Boston). p.413-24 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

By employing a clinical body counter and the long-life gamma-ray emitter Na^{22}, a method for studying sodium metabolism in human subjects was developed which appears to be superior to the conventional balance techniques. The clinical body counter is composed of a 4 × 4-in. sodium iodide crystal enclosed in a cylindrical 5-in.-thick steel shield with the open end facing the subject. At the start of the study a tracer dose of 10 to 20 μc of Na^{22} is administered intravenously. The sensitivity of the clinical body counter is sufficient to determine the Na^{22} body retention by daily measurements until the remaining radioactivity is reduced to about 0.1 μc. The exchangeable body sodium was determined from Na^{22} body retention (% of dose) and serum sodium specific activity (% of dose/meq). While the measured sodium intake was varied from less than 1 meq to 300 meq per day, 5 normal individuals were studied for periods of 30 to 70 d. A group of 15 patients with edema of either cardiac, hepatic, or renal origin were followed for up to 150 d while various diuretic measures were carried out. In the same subjects the controversial question concerning the existence of a slowly exchangeable sodium pool, consisting mainly of bone sodium, was investigated with two small sodium iodide crystals placed near the bony sites of the knee and the posterior aspect of the head. Daily measurements over these sites were made simultaneously with the body counting. The results of the clinical studies are summarized. (auth)

16157 DETERMINATION OF TOTAL BODY POTASSIUM BY POTASSIUM-40 MEASUREMENTS IN PATIENTS WITH MUSCULAR DYSTROPHY AND RELATED DISEASES. William H. Blahd, Benedict Cassen, and Marianne Lederer (Veterans Administration Center, Los Angeles and Univ. of California, Los Angeles). p.427-32 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

Total-body potassium levels were determined in a group of 38 patients with muscular dystrophy and myotonia atrophica by means of K^{40} measurements in a whole-body sodium iodide crystal scintillation counter. The results have been compared with values obtained from K^{40} measurement of normal individuals of comparable age, weight and body size. Muscular dystrophy patients showed moderate to severe depression of body potassium. In general the level of body potassium seemed to be correlated with the severity of disease involvement. Decreased body potassium levels were also observed in myotonia atrophica patients, but to a lesser degree and with less obvious correlation to the severity of their disease. Body potassium levels obtained in muscular dystrophy and myotonia atrophica patients by K^{40} measurements were also correlated with values obtained by K^{42}-exchange studies. In most patients lower potassium levels were obtained by the K^{40} method than with the K^{42}-exchange technique. Such differences were thought to represent progression of disease with loss of functional muscle mass during the relatively long interval between the earlier K^{42}-exchange studies and the more recent K^{40} measurements. In a few instances body potassium levels determined by the K^{42}-exchange technique were somewhat lower. This discrepancy was attributed to the incomplete exchange of K^{42} with all body tissues. Total-body potassium levels in a small group of siblings and first-generation progeny of dystrophic patients have also been studied. Remarkably decreased potassium levels have been observed in several apparently healthy first-generation male offsprings of muscular dystrophic patients. The implications of these findings in dystrophic patients and related individuals as well as the value of the whole-body counter in such investigations are discussed. (auth)

16158 THE USE OF WHOLE-BODY COUNTING TECHNIQUES IN CLINICAL STUDIES WITH Fe^{59}, Na^{22}, Br^{82}, Co^{58}-LABELLED VITAMIN B$_{12}$ AND I^{131}-LABELLED ALBUMIN. B. Malamos, E. H. Belcher, D. Binopoulos, and C. Constantinides (Univ. of Athens and Alexandra Hospital, Athens). p.435-44 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

A whole-body counting system comprising a single scintillation detector with a 4-in. × 3-in. thallium-activated sodium iodide crystal coupled to a 256-channel pulse-height analyzer with cathode-ray tube display and pen recorder and print-out facilities was used in the study of a number of clinical problems. These include measurements of absorption of iron from the gastro-intestinal tract after oral administration of test doses of Fe^{59}, similar measurements of gastro-intestinal absorption of vitamin B_{12} using Co^{58}-labeled vitamin as tracer, studies of the changes induced by diuretic drugs in extracellular fluid volume measured with orally administered Br^{82}, and studies of protein turnover measured with intravenously injected I^{131}-labeled human serum albumin. The counting system is installed in a conventional laboratory without special shielding. Preliminary results of these studies which illustrate the potentialities and limitations of whole-body counting techniques are presented. (auth)

16159 APPLICATION OF WHOLE-BODY GAMMA SPECTROMETRY TO CLINICAL TRACER STUDIES. S. H. Cohn, S. W. Lippincott, E. P. Cronkite, and P. G. Reizenstein (Brookhaven National Lab., Upton, N. Y.). p.469-80 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (BNL-5461). (In English)

The Brookhaven National Laboratory's whole-body gamma spectrometer has been employed in a number of clinical studies for measuring the retention of very low levels of isotopes or labeled compounds in patients. Three studies are presented in detail. The first is a study of the turnover of I^{131}-labeled albumin and globulin in patients with various neoplastic diseases. In the second study the absorption and turnover of free vitamin B_{12} labeled with Co^{58} and intrinsic-factor-bound vitamin B_{12} labeled with Co^{60} were determined in patients with pernicious anemia or deficient intestinal absorption of vitamin B_{12}. The third study is concerned with the measurement of several parameters of the skeletal metabolism of patients with various pathological conditions using Sr^{85} and Ca^{47} as the tracers. The advantages of whole-body counting over the previous technique of radioactive assay of serum and excreta are discussed. In particular, the possibilities offered by whole-body counting in the area of very long-term studies with very low levels of isotopes are pointed out. Special advantages, such as the high-energy resolution capacity which permits double-tracer studies to be carried out, are discussed. At the same time, such difficulties as the anomalous changes observed before the isotopic tracer achieves equilibrium in the body are also considered. (auth)

16160 METABOLIC STUDIES WITH Fe^{59}, Ca^{47} AND C^{11} IN VARIOUS DISEASES. Thornton W. Sargent (Univ. of California, Berkeley). p.447-66 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

Studies are under way to apply a wide variety of gamma-emitting isotopes to the investigation of human disease states with the human whole-body gamma-ray spectrometer. Results are reported on the following work now in progress. Oral absorption and long-term retention of Fe^{59} has been studied in patients with diseases of iron metaboliism, such as hemachromatosis, telangiectasia, and various anemias, and correlated with iron kinetics studies. Patients with advanced cancer, acromegaly, and diabetes have been hypophysectomized by the alpha beam of the 184-in. cyclotron. A positron-emitting isotope, C^{11}, was found to be induced in the tissues of these patients; its elimination from the body has been studied with the whole-body counter and with a radioactive breath analyzer. A patient with acromegaly due to a pituitary tumor was given Ca^{47} and his calcium turnover studied by whole-body counting and correlated with serum and urine measurements. This study was compared with that for a normal volunteer. Other isotopic studies planned and under study are discussed. (auth)

16161 CLINICAL USE OF A NaI(Tl) BODY COUNTER. E. S. Cederquist and K. V. H. Lidén (Univ. of Lund, Sweden). p.487-97 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

The advantages of direct external total retention measurements with the whole-body counting technique are discussed. The difficulties in obtaining a 100% collection of excreta for retention studies over an extended period of time are described. In most clinical tracer studies an exchange of activity between different compartments occurs. This requires that the whole-body counting geometry be insensitive to local deposits of activity. The experience with the bed geometry with scanning technique is described. The low-background scintillation whole-body counting technique allows the use of very low levels of activity, which means that otherwise clinically unsuitable isotopes can be used. The sensitivity of the method also permits long-term studies of retention which are impractical by excretion measurements. Some clinical applications of Sr^{85} and Ca^{47} are used as illustrations, e.g. Sr^{85} and Ca^{47} in a study of patients with primary bone tumors and skeletal metastases and in some normal cases. The importance in some cases of combined whole-body measurements and point measurements with a collimated crystal is discussed. The retention of I^{131} has been followed in some patients with follicular thyroid cancer with and without known metastases and in patients with thyrotoxicosis and some normal cases. Clinical studies with Co^{57}-labeled Vitamin B_{12} are described. (auth)

16162 RECENT USES OF A TOTAL-BODY COUNTER FACILITY IN METABOLIC RESEARCH AND CLINICAL DIAGNOSIS WITH RADIONUCLIDES. Norman S. MacDonald (Univ. of California, Los Angeles). p.501-14 of "Whole-Body Counting." Vienna, International Atomic Energy Agency, 1962. (In English)

A combination of a thick-walled, moderately sized steel chamber of the Argonne type with an array of four matched NaI scintillation detectors and electronic equipment for multi-channel pulse-height analysis constitutes an exceptionally versatile facility for the study of gamma-emitting radionuclides present in the human body, whether by reason of inadvertent exposure or intentional administration for medical purposes. The excellent sensitivity and energy resolution of the instrument system is demonstrated by detection of Sb^{124} (0.61 Mev) in the presence of the normal burden of Cs^{137} (0.67 Mev) in the body of a laboratory worker. Use of a Hg collimating shield has yielded data on the pulmonary retention and physiological turnover of Mn^{54} in a case of accidental inhalation of dust containing fission products and neutron-activation products. However, the greatest potentialities of total-body counter assemblies lie in their application to clinical research. By measurement of total-body retention of radiocobalt-labelled Vitamin B_{12}, the diagnosis of pernicious anemia has been accomplished conveniently with doses of only 0.02 μc. The use of a Co^{58} label and the total-body counter facility greatly reduces the dose of radiation to the patient. The results are not altered by the presence of other radionuclides in the patient resulting from prior tests also involving radioisotopes. Aberrations in the metabolism of thyroxine are currently under study by measurements of the daily loss of I^{131} following intravenous injection of 0.03 μc of I^{131}-labeled thyroxine and oral administration of KI. The study of the behavior of Sr^{85} immediately after injection into patients with osteoporosis and other skeletal disorders has aided diagnosis of such disease. By conducting the radioisotope osteogram test inside the low-background chamber and using large crystal detectors, the administered dose can be reduced to sub-microcurie levels. Body retention is measurable over a period of months. Another diagnostic application is the evaluation of abnormal loss of serum protein into the intestine. I^{131}-labeled serum albumin is injected intravenously and the daily loss is determined by total-body counting. The thyroid uptake of I^{131} split off from circulating tagged albumin is blocked by oral administration of KI. (auth)

16163 TELETHERAPY HEAD HAVING SHIELDING CARRIER FOR RADIOACTIVE SOURCE. Robert V. Wolf (to Nuclear Corp. of America, Inc.). U. S. Patent 3,032,661. May 1, 1962.

A shielded teletherapy head is designed with maximum shielding of the source in both the safety and radiation positions and with a fail-safe control means for accurately registering the source with the radiation aperture and for emergency return to the safety position. The head comprises a sphere of shielding material with an interior tubular track. A motor moves the source in the track from the safety position to the radiation position, and the control means for returning the source to the safety position is a compressed spring. (D.L.C.)

16164 ERYTHROPOIETIC FACTOR PURIFICATION. Wilfrid F. White and Robert J. Schlueter (to U. S. Atomic Energy Commission). U. S. Patent 3,033,753. May 8, 1962.

A method is given for purifying and concentrating the blood plasma erythropoietic factor. Anemic sheep plasma is contacted three times successively with ion exchange resins: an anion exchange resin, a cation exchange resin at a pH of about 5, and a cation exchange resin at a pH of about 6. (AEC)

Biochemistry, Nutrition, and Toxicology

16165 ASHING PROCEDURES FOR DETERMINATION OF CESIUM IN PLANT AND ANIMAL TISSUES. Clifton Blincoe (Univ. of Nevada, Reno). Anal. Chem., 34: 715-16 (May 1962).

Rats were injected with 0.03 mc of high specific activity Cs^{134} (3000 mc per mg) and samples of skeletal muscle, liver, and long bone were assayed for Cs^{134} by γ counting the fresh sample using a well-type scintillation counter, pulse-height analyzer, and scaler. Samples in plastic tubes were then digested or ashed, and the Cs^{134} again determined. Alfalfa plants containing Cs^{134} were prepared by allowing the plant to take up Cs^{134} from an aqueous medium. Samples of the aerial portions were dried, ground, and treated in the same manner as the animal tissues. Wet digestion was with concentrated nitric acid alone. Dry ashing was accomplished at 550°C after slowly increasing the temperature over a 6 hr period to prevent loss of sample by splattering. Data indicate quantitative recovery of Cs through wet digestion of soft tissues and alfalfa. Dry ashing at 550°C resulted in losses of 8 to 15% of the Cs from soft tissues but not from bone. No losses of Na or K were reported in dry ashing at 550°C. (P.C.H.)

16166 IMPROVED SOLVENT SYSTEMS FOR LIQUID SCINTILLATION COUNTING OF BODY FLUIDS AND TISSUES. R. C. Meade and R. A. Stiglitz (Marquette Univ., Milwaukee). Intern. J. Appl. Radiation and Isotopes, 13: 11-14(Jan. 1962). (In English)

Several systems capable of incorporating body fluids or tissues in a liquid scintillation counting solvent were compared. Body fluids and water are counted most efficiently in a Hyamine-10X—methanol—toluene system. Moist tissues are readily ground in a Triton-X-100—toluene mixture and the counting efficiency approaches that of toluene. (auth)

16167 A DISTRIBUTION STUDY OF F^{18}-LABELLED CATIONIC FLUOROCOMPLEXES IN RATS. M. Anbar and N. Ernst (Weizmann Inst. of Science, Rehovoth, Israel and Israel Atomic Energy Commission Research Labs., Rehovoth). Intern. J. Appl. Radiation and Isotopes, 13: 47-51(Jan. 1962). (In English)

The distribution of fluorine activity in various tissues of rats was investigated using NaF^{18} in presence of EDTA, zirconium, scandium, and yttrium ions. The patterns of fluorine distribution and excretion were altered by cations which form stable fluorocomplexes and by EDTA. (auth)

16168 THE UTILIZATION OF RADIOACTIVE CESIUM FOR GAMMATHERAPY. M. A. Volkova and S. G. Pel'man (Gertsen State Scientific Research Inst. of Oncology, USSR). Med. Radiol., 7: No. 3, 3-5(Mar. 1962). (In Russian)

A description of the use of radioactive cesium for short-focus gammatherapy is given. Radioactive cesium is arranged in two circles in the form of individual preparations of 0.5 and 0.4 g eq r each, in the quantity of 20, the total activity amounting to 9.5 g eq r. The treatment was effected daily with a single dose of 200 r, with the dose capacity 6.5 hr/min; field size 5 cm diameter, skin-focus distance 6 cm. 85 patients with tumors of the tongue and mucosa of the oral cavity and parotid gland were under observation. Studies of the local reaction in comparison with Co^{60} irradiation demonstrate that the skin reaction in the cesium source appears 3–5 days earlier and from a lesser dose, however the course is milder and the process terminates sooner with radiation changes of tissues pronounced to a lesser degree. (auth)

16169 THE RATIO OF RADIOACTIVE ERYTHROCYTES AND BLOOD PLASMA AS AN INDEX OF THE FUNCTIONAL STATE OF THE THYROID GLAND. E. D. Chebotareva (Khar'kov Inst. of Medical Radiology). Med. Radiol., 7: No. 3, 6-8(Mar. 1962). (In Russian)

Assessment was made of the functional activity of the thyroid gland by determining the ratio of erythrocyte and blood plasma radioactivity after Guerin's method, which is based on the distribution of organic and inorganic fractions of radioiodine. The results obtained testify to the practical value of the method for the diagnosis of thyrotoxicosis. (auth)

16170 GEOMETRIC FACTORS AND PHYSICS OF THYROID SCANNING. C. Picchio (Ospedale di Circolo, Busto Arsizio, Italy). Minerva nucleare, 5: 339-48(Dec. 1961). (In Italian)

The geometrical factors involved in the formation of scanographic images and the statistical significance of the contrast obtained are considered in order to establish the range within which a scanogram can be considered a satisfactory means of determining the shape and size of a radioactive organ. (auth)

16171 RETENTION OF RADIUM IN MAN FROM TWENTY TO TWENTY-NINE YEARS AFTER INTRAVENOUS ADMINISTRATION AND SOME OF ITS PHYSIOLOGIC IMPLICATIONS. L. D. Marinelli, C. E. Miller, and H. F. Lucas, Jr. (Argonne National Lab., Ill.). Radiology, 78: 544-52(Apr. 1962).

The retention of Ra^{226} in human beings, 20 to 28.8 years after intravenous injection, was determined by measuring in 1951 and in 1960 the whole-body radium content of a group of mental patients injected with 70 to 410 μc of the element in 1931. The average decrease of the whole-body γ-ray activity between 1951 and 1960 was found to be somewhat greater than that predicted by Norris et al. in 1955, but not entirely outside that expected from experimental error. The average Rn/total Ra ratio (≈ 0.69) did not vary sensibly in the interim, but the differences in the individual rates of elimination noted in 1953 seem to have persisted, and in two patients apparently increased, during the succeeding nine years. It is suggested that these patients offer an excellent opportunity to study the onset of subclinical osteoporosis and the possible correlation of Ra elimination with endocrinological factors. (auth)

Fallout and Ecology

16172 (TID-15385) TRANSLOCATION OF PHOSPHORUS IN A TROUT STREAM ECOSYSTEM. Progress Report, June 14, 1961 to March 7, 1962. Robert C. Ball (Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife) and Frank F. Hooper (Michigan. Inst. for Fisheries Research, Ann Arbor and Michigan. Univ., Ann Arbor). Contract AT(11-1)-655. 47p.

The movement of radiophosphorus through the ecosystem of a cold-water stream was studied by adding a spike of approximately 23 mc of P^{32} to the water during the summers of 1958, 1959, and 1960. The period of time required for the spike to pass various points in the study area was from 33 min at the most upstream point to 180 min at a point farthest downstream. The theoretical maximum water concentration from the spike was 1.22×10^{-5} mc/ml. The average distance a P^{32} atom traveled before being removed from the water varied 450 to 11,236 yards. There was a large year-to-year difference in the form in which the P^{32} was present while in stream water. Much of the uptake from the water appeared to be by periphyton and by 3 species of aquatic macrophytes (Potamogeton, Chara, and Fontinalis). All of these plants had a maximum concentration of P^{32} soon after the spike passed through the area. The rate of loss of P^{32} from the plant to the water was initially high but decreased with time. The concentration approached an equilibrium level in 15 to 20 days after the spike was released. A measure of the level of re-cycled phosphorus in the stream water was obtained by exposing the periphyton growing on artificial substrates to this source of phosphorus. Concentration curves for consumer organisms within the ecosystem reflected both differences in metabolic turnover rates and food relationships. Differences in the manner in which the spike circulated through the ecosystem are believed to be largely the result of a difference in distribution of P^{32} between the soluble and particulate phases. (auth)

16173 HIGH BACKGROUND RADIATION ON A SMALL ISLAND. R. N. Weir (Queen Elizabeth Central Hospital, Blantyre, Rhodesia and Nyasaland). Nature, 194: 265-7 (Apr. 21, 1962).

Results are given for a preliminary survey conducted in 1954 on the population of Chilwa Island, Nyasaland, which has marked radioactive anomalies. The background radiation was estimated to be ~30 times normal, and a village lying nearest the center of a populated radioactive area was used as the test village, with a village outside the area as the control village. The most significant results of the survey were that the white cell count in the test village was significantly lower than in the control village and that three cases of skin disease resembling skin reactions to deep x-ray therapy were found in the test village. (D.L.C.)

Radiation Effects on Living Tissues

16174 (ASD-TR-61-195) BIOMEDICAL EFFECTS OF EXPOSURE TO ELECTROMAGNETIC RADIATION. PART II. BIOMEDICAL EFFECTS ON THE EYE FROM EXPOSURE TO MICROWAVES AND IONIZING RADIATIONS. Archibald R. Buchanan, Harold C. Heim, and Jack J. Kraushaar (Physics, Engineering, Chemistry Corp., Boulder, Colo.). June 1961. Contract AF33(616)-6305. 166p. (AD-265279)

A search of the literature revealed that ionizing radiations produce deleterious ocular effects, the most prominent being the development of cataracts. Retinal damage was also reported. The threshold dose for ocular damage was not definitely established but a single large dose of radiation seems more harmful to the lens than an equivalent amount of small radiation doses. A considerable number of studies were devoted to the effects of ionizing radiation upon biochemical processes of the eye. The effects of x rays were studied in some detail, but almost no information exists on the effects of neutrons, protons, mesons, microwaves, and ultrasonic radiation. (auth)

16175 (ASD-TR-61-415) A STUDY TO DETERMINE THE RELATIVE BIOLOGICAL EFFECTIVENESS OF NEUTRONS BY CORRELATING THE PHYSIOLOGICAL CHANGES OF THE EYE TO X-RADIATION. Jerry Hart Jacobson and David L. Krohn (New York Eye and Ear Infirmary, New York). Aug. 1961. Contract AF33(616)-7127. 110p. (AD-267044)

The heads of white albino rabbits were exposed to two x-ray units with differing parameters, and to pile radiation from a critical reactor, using four different moderator thicknesses. Estimations were made of the extent of tissue damage in the eyes by observations of the effects on the electroretinogram, biochemical determinations, histopathological and clinical observations, in the attempt to derive an RBE (relative biological effectiveness) for acute retinal changes. The RBE derived for thermal neutrons at 24 hours post-radiation varied considerably with the different indicators, but appeared to be not less than 1 and not greater than 3. Higher energy neutrons appeared to have a much higher relative biological effectiveness. (auth)

16176 (NP-11578) THE EFFECT OF IONIZING RADIATION ON THE AVAILABILITY OF INORGANIC IONS IN SOILS. H. J. M. Bowen and P. A. Cawse (United Kingdom Atomic Energy Authority. Research Group. Wantage Research Lab., Wantage, Berks, England). [nd]. 14p. (SM-23/3)

The effects of moderate to high doses of gamma radiation on the availability of inorganic nutrients in eight soils were examined. Samples were irradiated at room temperature in sealed polyethylene bags without prior dryings. The samples were analyzed for N, P, Fe, K, Mn, Cu, and Zn. Soil samples were tested with surface sterilized seeds of peas for the development of root nodules. For phytotoxicity trials, seeds of lettuce were sown in the soil. Peas failed to nodulate in soils treated with more than 2 Mr. Observations on pH and nutrient status of the soils before and after irradiation are given in tables. Consistent stimulation of plant growth was found in irradiated soils. It was concluded that this resulted from an effect of radiation on the biological constituents. Irradiation gave a small increase in ammonia nitrogen and exchangeable manganese. The irradiation did not effect exchangeable nitrate, Cu, P, K, Fe, or Zn. (M.C.G.)

16177 (NYO-10056) LUNG CANCER IN RATS FROM INTRATRACHEALLY INJECTED RADIOACTIVE CERIUM AS $Ce^{144}F_3$ AND $Ce^{144}Cl_3$. Herman Cember (Cincinnati. Univ. Kettering Lab.). Mar. 31, 1962. Contract AT(30-1)-2674. 43p.

Ce^{144} as one micron diameter $Ce^{144}F_3$ particulates produced lung cancer in rats when intratracheally injected at dose of levels of 0.5, 1, 2, and 4 μc. The tumor frequency in each of these treatment levels was 8/41, 6/44, 4/34, and 14/42 respectively. In the lowest dose level, the first death due to lung cancer, fibrosarcoma, occurred 528 days after exposure. The radiation dose to the lungs in this case was 600 rad. Soluble Ce^{144}, as $Ce^{144}Cl_3$, solution, was found to be a pulmonary carcinogen when intratracheally injected in doses of 10, 15, and 30 microcuries. The tumor frequency in each of the treatment levels was 9/61, 31/52, and 26/37 respectively. The earliest tumor due to soluble Ce^{144} was a squamous cell carcinoma which was found in a rat that died only 70 days after exposure to 30 μc and an absorbed dose of 25000 rad. Insofar as extrapolation of these experimental data from rat to man is valid, the results of this experiment imply: that the toxicity of atmospheric Ce^{144} is greater than that assumed at the present time, and that the lung should be considered a critical organ for purposes of setting maximum allowable atmospheric concentrations of Ce^{144}. (auth)

16178 (USNRDL-TR-553) DIFFERENCES IN THE REJECTION OF SKIN TRANSPLANTS AND BLOOD CELLS OF BONE MARROW DONOR ORIGIN BY RADIATION INDUCED CHIMERAS. M. S. Silverman and P. H. Chin (Naval Radiological Defense Lab., San Francisco). Mar. 16, 1962. 24p.

$(C57L \times A)F_1$ mice which had survived lethal doses of x radiation when injected with rat bone marrow are frequently found to have rat circulating blood cells. These cells often persist for the remainder of the animal's life. In addition the mouse/rat chimeras will also accept donor rat skin grafts. The acceptance or rejection of the skin grafts is often used to determine the immunological tolerant state of the chimera. However, the data described in this report indicate that the circulating blood cells may persist in about 50% of these mice although rejection of the skin grafts occurs. Some of these partially tolerant mice are capable of producing antibodies against sheep red blood cells, but not against rat blood cells of either donor or allelogeneic orgin. Mice which have reverted to a completely non-tolerant state reject both the rat skin grafts and rat circulating blood cells, and form antibodies against the donor red blood cells. Three possible explanations for partial tolerance are offered, none of which are mutually exclusive. (auth)

16179 (JPRS-13154) INVESTIGATION OF EARLY REACTIONS OF THE ORGANISM TO RADIATION EFFECT. Translation of part of the book "Issledovanie Rannikh Reaktsii Organizma na Radiatsionnoe Vozdeistvie" p.5-13; 167-221, Moscow, 1960. 62p.

Six papers are included which treat radiation effects on regulation processes in organisms, on muscles, and on the brain. Separate abstracts were prepared for all the papers. A brief discussion of the conclusions from the papers and a bibliography of 62 references are given. (D.L.C.)

16180 (JPRS-13154(p.1-8)) RADIATION REACTIONS AS DISTURBANCE OF REGULATION CAPACITY OF VITAL PHENOMENA. G. M. Frank. Translated from "Issledovanie Rannikh Reaktsii Organizma na Radiatsionnoe Vozdeistvie."

Research in radiobiology is critically reviewed. The use of data on simple systems for analysis of the biological effects of radiation on complex multicellular and higher organisms is discussed. It is suggested that research on physicochemical changes be conducted in parallel on tissue in vivo and on isolated tissue in vitro. The importance of local changes in radiobiological effects is emphasized. The periodic nature of certain functional manifestations, e.g., the electric activity of cells and tissues, is discussed. (D.L.C.)

16181 (JPRS-13154(p.8-15)) FEATURES OF PHYSICOCHEMICAL CHANGES IN THE CENTRAL NERVOUS SYSTEM DURING VARIOUS PERIODS OF RADIATION REACTION. N. A. Aladzhalova. Translated from "Issledovanie Rannikh Reaktsii Organizma na Radiatsionnoe Vozdeistvie."

The "concealed period" of radiation sickness was investigated by irradiating three types of frog muscles with 5,000 to 100,000 r x rays and determining the angle of dielectric losses at two frequencies, 10,000 and 200,000 cps. For the lower x-ray doses which did not produce any change, supplementary irradiation with infrared brought about a change in the loss angle. Irradiation experiments were also conducted on denervated muscle. The implications of the results are discussed. (D.L.C.)

16182 (JPRS-13154(p.15-20)) EFFECT OF RADIATION ON PHYSICOCHEMICAL PROCESSES IN THE BRAIN—INTRODUCTION. Translated from "Issledovanie Rannikh Reaktsii Organizma na Radiatsionnoe Vozdeistvie."

Research on radiation effects on the brain is reviewed. Four stages of radiation sickness are outlined. Morphological changes in the brain due to irradiation are described. Radiation effects on the excitability, conditioned reflex behavior, electric activity, and afferent impulsation of the brain are discussed. (D.L.C.)

16183 (JPRS-13154(p.21-34)) EFFECT OF RADIATION ON THE ELECTROCONDUCTION PROPERTIES OF THE CEREBRAL CORTEX. Translated from "Issledovanie Rannikh Reaktsii Organizma na Radiatsionnoe Vozdeistvie."

Data are presented which support the hypothesis that changes in the cerebral cortex impedance reflection processes in the upper dendrite layers of the cortex. Rabbits were x irradiated under varying conditions (local irradiation of head, total-body irradiation, abdominal irradiation, etc.) and the cortex resistance and capacity measured at intervals up to 10 days after irradiation at a frequency of 10,000 cps. The radiation effects on the cortex resistance are divided into phases. (D.L.C.)

16184 (JPRS-13154(p.34-8)) RADIATION EFFECT ON ULTRASLOW FLUCTUATIONS OF POTENTIAL IN CEREBRAL STRUCTURES. Translated from "Issledovanie Rannikh Reaktsii Organizma na Radiatsionnoe Vozdeistvie."

A potential undergoing extremely slow rhythmic changes was isolated in the cerebral cortex. The ultraslow changes consist of two rhythms, one with a period of 8 to 10 sec and the other with a period of 0.75 to 2 min. The characteristics of the ultraslow fluctuations are described, and some of the functional and pathological agents which influence the fluctuations are discussed. (D.L.C.)

16185 (JPRS-13154(p.38-55)) INFLUENCE OF IRRADIATION OF VARYING LOCALIZATION AND DOSAGE ON ULTRASLOW RHYTHMIC FLUCTUATIONS OF POTENTIAL IN THE CEREBRAL CORTEX. Translated from "Issledovanie Rannikh Reaktsii Organizma na Radiatsionnoe Vozdeistvie."

The effects of irradiation of the head, abdominal region, and total body on the ultraslow rhythmic fluctuations of the cerebral cortex potential were investigated. The topography of ultraslow fluctuations in the thalamus and hypothalamus before and after irradiation is given. It is concluded that radiation is the extreme stimulator which can cause ultraslow fluctuations in the thalamus. (D.L.C.)

16186 SYMPOSIUM ON AEROSPACE RADIOBIOLOGY. I. SOLAR INFLUENCES ON THE RADIATION FIELD IN

SPACE. J. R. Winckler (Univ. of Minnesota, Minneapolis). Aerospace Med., 32: 893-900(Oct. 1961).

Knowledge about a series of fourteen solar cosmic ray events is summarized. The events, which include most of the larger ones of the period from 1958 to 1960, were selected because direct measurements were made on the primary particles with balloons or rockets. Discussion is given on energy spectra and composition of the solar cosmic rays and time variations and the resulting implications about propagation from sun to earth. It is pointed out that the number of large flares per year which may produce events of the type of the 14 analyzed is at present dropping rapidly as the solar cycle wanes. It is expected, though, that activity will again increase about 1966-67 and thereafter. (P.C.H.)

16187 SYMPOSIUM ON AEROSPACE RADIOBIOLOGY. II. ON THE SHIELDING OF COSMIC RAYS. S. P. Shen (St. John's Univ., Jamaica, N. Y. and New York Univ., New York). Aerospace Med., 32: 901-8(Oct. 1961).

Discussion is given on the nuclear physics problem of cosmic ray shielding and also on the question: Given a parallel beam of particles incident perpendicularly and uniformly over the face of a plane shield of great thickness, what is the radiation flux at every depth inside the shield? Some attentuation data are also given. (P.C.H.)

16188 SYMPOSIUM ON AEROSPACE RADIOBIOLOGY. III. THE ROLE OF THE TIME FACTOR IN THE DOSIMETRY OF IONIZING RADIATION IN SPACE. Hermann J. Schaefer (U. S. Naval School of Aviation Medicine, Pensacola, Fla.). Aerospace Med., 32: 909-14(Oct. 1961).

Discussion is given on experiments and the importance of the time factor in space flight. However, it is felt that the designation of a fixed rem value for the permissible or emergency dose in a space mission is unrealistic. Closely related to the time factor influence acting during exposure is the recovery process acting after termination of exposure. A third factor considered in assessing radiation hazards in space exists for the damage from low level exposure to heavy nuclei. In this case, the time factor acts in the direction of increasing the damage from small doses of heavy nuclei as compared to x or gamma rays. The time factor influence concerning heavy nuclei effects carries the greater practical significance since its long term effects will be hard to identify, yet will have to be considered in such projects as manned orbiting satellites and space platforms or passenger transportation in the heavy nuclei region. (P.C.H.)

16189 SYMPOSIUM ON AEROSPACE RADIOBIOLOGY. IV. BIOLOGICAL EFFECTS OF ACCELERATED HEAVY IONS. R. A. Deering, Franklin Hutchinson, and Philip E. Schambra (Yale Univ., New Haven). Aerospace Med., 32: 915-20(Oct. 1961).

Results on the effects of 10 Mev/nucleon heavy ions on enzymes, deoxyribonucleic acid, virus, bacteria, yeast, mammalian cells, and Artemia eggs are presented. Three different situations relating to Relative Biological Efficiency (RBE) determinations are discussed: exponential survivals from both gamma rays and heavy ions; sigmoidal survivals, related by dose reduction factors, for all radiations studied, and sigmoidal survival from x or gamma rays but exponential survivals from heavy ions. For all systems studied, except mammalian cells and Artemia eggs, definite RBE's can be determined. These RBE's are quite small in general and are tabulated in the text. For mammalian cells (HeLa) and Artemia eggs, the survival curves change from sigmoidal at very low LET to exponential at LET's of the carbon ions, or above. Thus, no definite and constant RBE's can be quoted, since they are functions of the radiation dose. For these systems, the most important effect of the heavy ions is to decrease or eliminate the low dose shoulder on the survival curves that is observed for low LET radiations. When compared in terms of equal energy absorption (rads), this makes the heavy ions much more effective than gamma or x rays, particularly at doses where x rays would normally give no or little inactivation. (auth)

16190 SYMPOSIUM ON AEROSPACE RADIOBIOLOGY. V. HEAVY ION AND MILLIBEAM IRRADIATIONS ON MAMMALIAN TISSUE. Herman B. Chase, William E. Straile, and Claudette Arsenault (Brown Univ., Providence). Aerospace Med., 32: 921-4(Oct. 1961).

Discussion is given on tissue responses to variations in heavy ions and an electron beam all with restricted ranges in tissue, variations in cosmic ray heavy particle thindowns, and variations in size of beam, all of which produce effects with certain pertinent differences. Special attention is given to indirect and delayed effects in the skin. It is concluded that the greying response is not solely a cellular damage but reflects to some extent an effect on the upper follicle. This is believed to be an important conclusion in predicting damage from cosmic ray heavy ions. (P.C.H.)

16191 SYMPOSIUM ON AEROSPACE RADIOBIOLOGY. VI. GENETIC STUDIES IN THE LOWER RADIATION BELT. PRELIMINARY ASSAY OF NERV NO. 1 SAMPLES. A. Gib De Busk (Florida State Univ., Tallahassee). Aerospace Med., 32: 925-31(Oct. 1961).

Preliminary genetic and physiological studies of conidia of *Neurospora crassa* exposed to flight conditions for 26 minutes penetrating to an altitude of 1180 miles into the lower radiation belt are reported. A surprisingly high level of mutation was noted in the experimental cells when compared with three sets of control cells. A further unexpected phenomena referred to as physiological injury was noted in the same set of experimental cells. This physiological injury phenomena could be at least partially reversed by certain organic acids which are known to function in cellular energy conversions. It was not possible to determine what specific factor of flight, if any, contributed or caused either phenomena observed. (auth)

16192 SYMPOSIUM ON AEROSPACE RADIOBIOLOGY. VII. REVIEW OF BIOLOGICAL EFFECTS OF GALACTIC COSMIC RADIATION. David G. Simons and John E. Hewitt (School of Aerospace Medicine, Brooks AFB, Tex.). Aerospace Med., 32: 932-41(Oct. 1961).

Discussion is given on galactic cosmic radiation, but some aspects of solar cosmic rays are mentioned for comparison since the two overlap in composition and energy. The biologic effects of space radiations are interpreted in terms of two physical models: a multiple agent and a single agent model. Comparison of results obtained from rockets, balloons, and satellites shows that for the study of the effects of track-producing heavy primary cosmic radiation, high altitude balloon flights are most satisfactory. Results of the discussion emphasize the need for developing techniques which are practical for monitoring biological specimens but which will identify more accurately both the charge and energy of galactic primary particles. (P.C.H.)

16193 SYMPOSIUM ON AEROSPACE RADIOBIOLOGY. VIII. COSMIC RADIATION—LABORATORY OBSERVATIONS. Robert W. Zellmer and Ralph G. Allen, Jr. (School of Aerospace Medicine, Brooks AFB, Tex.). Aerospace Med., 32: 942-6(Oct. 1961).

Forty-eight Macaca mulatta primates were exposed to a beam of 730 Mev protons or 910 Mev alphas focused on the eyes in varying total dosages. The effects of this exposure were evaluated clinically, and from these data estimations were made of the threshold doses necessary to produce iridocyclitis, erythema, epilation, and desquamation. These threshold doses were then compared to those obtained in previous studies using Co^{60} gamma radiation and RBE's were obtained. The inference is drawn that the RBE for protons will approximate 2, and for alphas will be quite close to 1. (auth)

16194 THE DELAYED EFFECTS OF EXTERNAL GAMMA IRRADIATION ON THE BONES OF RATS. Renato Baserga, Hermann Lisco, and Donald B. Cater (Northwestern Univ., Chicago; Argonne National Lab., Ill.; and Cambridge Univ., Eng.). Am. J. Pathol., 39: 455-72(Oct. 1961).

The delayed effects of external radiation were investigated in rats with both knee joints irradiated by 3000 r of gamma rays from an iridium-192 source. An attempt was made to correlate radiation damage and the incidence of bone neoplasm in the radiated area. The results indicated that under the conditions of the experiment, there was no correlation between the degree or the distribution of radiation damage and the incidence of tumors. A positive correlation was found to exist between incidence of tumors and the growth rate of tissue at the time of irradiation. (auth)

16195 INFLUENCE OF LOCAL ABDOMINAL RADIATION ON RESPONSE OF RABBITS TO NEPHROTOXIC SERUM. R. B. Arhelger, P. N. Smith, B. L. Walker, W. M. Fant, and J. G. Brunson (Univ. of Mississippi, Jackson). Am. J. Pathol., 39: 631-42(Dec. 1961).

Rabbits were given local abdominal radiation and nephrotoxic serum simultaneously or separately with varied intervals between radiation and serum injection. Control animals were given radiation or serum alone. Rabbits given nephrotoxic serum alone developed extensive glomerular endothelial proliferation. Glomeruli from animals given 570 r or 1140 r 18 hours before serum showed similar changes, and extensive lesions were present also when serum injection preceded radiation. In addition to endothelial proliferation, fibrinoid deposition between basement membranes and endothelium and within epithelial cytoplasm was observed in sections from animals given simultaneous radiation and serum. When 1140 r was given 36 hours prior to serum injection, or when 2280 r was given 18 hours before serum, glomerular proliferative lesions were observed but were much less extensive than in control animals given nephrotoxic serum alone. Only one of 20 rabbits exposed to 2280 r 36 hours prior to serum administration developed minimal proliferative changes. The remaining 19 showed normal glomerular structure with no evidence of endothelial proliferation, foot process smudging, or fibrinoid deposition. The results suggest that local abdominal radiation acts to prevent the development of nephrotoxic serum nephritis in rabbits by inhibiting localization of antiserum in the glomerular capillaries, thereby preventing a later reaction between the bound antiserum and autologous antibodies developed by the rabbit. (auth)

16196 SPLENIC WHITE PULP ALTERATION AFTER ANTIGEN INJECTION: RELATION TO TIME OF SERUM ANTIBODY PRODUCTION. C. C. Congdon and T. Makinodan (Oak Ridge National Lab., Tenn.). Am. J. Pathol., 39: 697-709(Dec. 1961).

Marked cellular alterations in the spleen white pulp occurred in mice given sheep red cells before serum antibody production could be detected. These changes also preceded the appearance of cellular proliferation in the red pulp. The histologic evidence favored the idea that the Ab-forming cells of the plasmacytic series in the red pulp were derived from the proliferating cells in the white pulp, and these in turn seemed to be derived from dissociated germinal center cells. (auth)

16197 THE EFFECT OF 5.3 Mev POLONIUM^{210} ALPHA-PARTICLES ON THE ELECTRICAL ACTIVITY OF α- AND β-FIBRES OF THE FROG SCIATIC NERVE. R. M. Bergstroem (Univ. of Helsinki). Ann. Med. Exptl. et Biol. Fenniae (Helsinki), 39: 211-15(1961). (In English)

Irradiation of small bundles of frog sciatic nerve with 5.3 Mev Po^{210} alpha particles results in an initial enhancement of the α- and β-potentials of the compound action potential. This enhancement, preceding the blocking of the conductivity of the fibers, appears earlier in the β- than in α-fibers. The decline of the potential due to the irradiation occurs in the β-fibers at a faster rate than in the α-fibers. (auth)

16198 STUDIES IN WOUND HEALING: IV. RETARDATION OF CONTRACTION BY LOCAL X-IRRADIATION, AND OBSERVATIONS RELATING TO THE ORIGIN OF FIBROBLASTS IN REPAIR. Hermes C. Grillo and Majic S. Potsaid (Huntington Memorial Hospital; Massachusetts General Hospital; and Harvard Univ., Boston). Ann. Surg., 154: 741-50(Nov. 1961).

Initiation and rate of skin wound closure by contraction in guinea pigs were retarded by moderate doses of local x irradiation (750 r). Complete closure ultimately occurred. Maximum effect followed irradiation between 24 and 48 hours after wounding; only slight effect followed radiation at five days or later. Depression of fibroblast formation, inhibition of capillary proliferation and disorganization of the architecture of repair resulted from irradiation, concomitantly with retardation of contraction. The data are consistent with a theory that wound closure by contraction may result from oriented cell migration. The findings support the probability of local origin of fibroblasts in wound repair. (auth)

16199 RADIOPROTECTIVE PROPERTIES OF A SYNTHETIC PREPARATION OF OXYTOCIN (SYNTOCINON SANDOZ) IN THE CASE OF MICE. Z. M. Bacq and M. L. Beaumariage (Université, Liège and Institut Interuniversitaire des Sciences Nucleaires, Brussels). Arch. intern. physiol. et biochim., 68: 516-18(May 1960). (In French)

Type-C$_{57}$ black mice are exposed to 650 r, after receiving injections of varying amounts of Syntocinon (oxytocin preparation). All uninjected control mice died within 16 days, but up to 85% of the mice protected by Syntocinon survived. (T.F.H.)

16200 RADIOPROTECTION OF MICE BY 5-HYDROXYTRYPTAMINE AND RELATED SUBSTANCES. Jean Renson (Université, Liège). Arch. intern. physiol. et biochim., 68: 531-4(May 1960). (In French)

The protective effects of several substances, injected intraperitoneally into type-C$_{57}$ mice 5 min prior to a 700-r whole-body irradiation, are determined and compared. In order of decreasing protectivity, the substances studied are 5-hydroxytryptamine, 5-hydroxytryptophane, 5-methoxytryptamine, bufotenine, and bufotenidine. (T.F.H.)

16201 THE MUTAGENIC EQUIVALENCE OF CONTINUOUS AND INTERMITTENT ULTRAVIOLET IN DROSOPHILA MELANOGASTER. Edgar Altenburg and Luolin S. Browning (Texas Medical Center, Inc., Houston and Rice Univ., Houston, Tex.). Genetics, 47: 273-6 (Mar. 1962).

No significant difference was detected in the lethal mutation rates induced in the second chromosome of Drosophila by treatment of the polar cap cells (early germ track) with 1.5 minutes continuous ultraviolet and with the same dose of ultraviolet in two periods of 45 seconds each, separated by an interval of 15 minutes (the rates being 1.8 ± 0.6% and 2.0 ± 0.8%, respectively). In a series of experiments previously reported, no significant difference was detected in the rates induced by a continuous 3.5-minute treatment, and the same dose of intermittent ultraviolet when the treatment was given in 15-second periods with 15-second intervals between periods (3.7 ± 1.3% and 3.7 ± 1.0%, respectively). If ultraviolet mutagenesis is a multihit event, these combined results indicate that the life-span of a hit is either appreciably less than the treatment periods in the earlier series, since in this case comparatively few hits would come close enough to the end of one period to act synergistically with those in the next, and only these would be prevented from being effective when the treatment was intermittent, or a hit lasts at least as long as the interval from the beginning of one treatment period to that of the next in the intermittent series of the present experiments, since all hits arising in the first period would then retain their capacity to act synergistically with hits in the second. The combined results of the earlier and present experiments also indicate that there is no change in mutagenic sensitivity to ultraviolet in the interval following a treatment. (auth)

16202 COMPARATIVE MUTAGENESIS OF THE DUMPY LOCUS IN DROSOPHILA MELANOGASTER. I. X-RAY TREATMENT OF MATURE SPERM—FREQUENCY AND DISTRIBUTION. E. A. Carlson and J. L. Southin (Univ. of California, Los Angeles). Genetics, 47: 321-36(Mar. 1962).

Evidence is presented to support the view that the majority of x-ray-induced mutations at the dumpy locus are gene mutations not associated with multibreakage events. Nonvariegated mosaicism at the dumpy locus is usually free of detectable breakage events. Complete mutations (those affecting the entire body) form a mixed class of breakage events and gene mutations. The mutation frequency of the dumpy gene was not altered when sperm bearing a pre-existing dumpy mutation were used for irradiation. Gross mutation detected at the clot locus is one tenth that of the dumpy locus. Criteria are evaluated for determining the true gene mutation frequencies at both loci. The results of the x-ray analysis of the dumpy locus support a theory of mutagenesis proposed by Muller, Carlson, and Schalet (1961). (auth)

16203 ASYNAPSIS AND MUTABILITY IN DROSOPHILA MELANOGASTER. P. E. Thompson (Oak Ridge National Lab., Tenn.). Genetics, 47: 337-49(Mar. 1962).

From analysis of salivary gland configurations and patterns of nondisjunction, it is estimated that the highly rearranged Second Multiple 5 (SM5) chromosome does not pair extensively with its homologue. The frequency of chromosome II lethal mutations was significantly higher among sperm from asynaptic SM5/+ males (19.5%) than among sperm from control males (8.6%) six to eight days after treatment with 1000 r of x rays. These sperm batches are interpreted as having been in or near meiosis at the time of irradiation. This sensitivity of SM5/+ males was found not to extend to the X chromosome after irradiation, indicating that such males do not have an inherently high mutability. The rate of spermiogenesis or sperm maturation in SM5/+ males and control males was compared by scoring induced crossovers, fecundity, and egg hatchability during single-day mating periods after irradiation. No difference in the pattern of these effects was observed, so that the maturation time of both groups of males is apparently the same. The interpretation that asynapsis is an important factor during meiosis is supported by these findings. It is suggested that during meiosis the synapsis of homologous chromosomes favors the repair of chromosomal disruptions over the formation of rearrangements, and that asynapsis may greatly increase the frequency of lethal mutations. (auth)

16204 THE PROPORTIONALITY BETWEEN MUTATION RATE AND ULTRAVIOLET DOSE AFTER PHOTOREACTIVATION IN DROSOPHILA. Luolin S. Browning and Edgar Altenburg (Rice Univ., Houston, Tex. and Texas Medical Center, Inc., Houston). Genetics, 47: 361-6(Mar. 1962).

The polar cap cells of Drosophila (early germ track cells) were posttreated with photoreactivating light after treatment with various doses of ultraviolet and the resulting lethal mutation rates compared with the rates induced by the same doses of ultraviolet in a nonposttreated series. In the nonposttreated, the dose-rate curve was found to rise rapidly at the lower doses employed, becoming less steep with increase in dose until it reaches a plateau, and finally falling off somewhat (these results confirming those earlier reported). By contrast, in the photoreactivated series, the dose-rate relationship appears best to fit a linear curve through the entire range of doses tested, the photoreactivated rates being well below those of the nonposttreated at the lower dosage ranges (0.7 ± 0.4% versus 5.9 ± 1.8% at the dose which shows the greatest difference), the difference in the rates getting less with increasing ultraviolet dose and the two rates (posttreated and nonposttreated) finally becoming much closer at the highest dose (2.5 ± 0.8% versus 4.3 ± 1.2%). These results would indicate that there is a difference in the nature of the photoreactivable and nonphotoreactivable parts of ultraviolet mutagenesis. (auth)

16205 USE OF IONIZING RADIATIONS FOR THE PRODUCTION OF NEW VARIETIES OF PLANTS. A. F. Bilquez (Institut d'Enseignement et de Recherches Tropicales, Bondy, France). Inds. atomiques, 5: No. 11-12, 73-9(1961). (In French)

It is known that ionizing radiations are capable of inducing hereditary variations in exposed organisms. Therefore it is possible to use them in a practical fashion in agronomy, along with traditional methods, for the creation of hereditary varieties useful in cultivated plants. The different methods capable of being used are studied with a consideration of the nature of the material to be irradiated, of the techniques available, and of the purpose to be attained. Emphasis is placed on the importance that certain factors of the medium (humidity and temperature) can have on the sensitivity shown by the plants. Some concrete examples are given of results obtained in this study, and indications on the direction future work should take are presented. (tr-auth)

16206 A STUDY OF RADIOSENSITIVE AND RADIORESISTANT MUTANTS OF ESCHERICHIA COLI STRAIN B. Ruth F. Hill and Eva Simson (Columbia Univ., New York). J. Gen. Microbiol., 24: 1-14(1961).

Relative differences in radiosensitivity between Escherichia coli strain B and the mutant strains, B/r (more resistant than B) and two types of B_s (more sensitive), are maintained with respect to inactivation by ultraviolet radiation, x rays, and decay of incorporated P^{32}. The differences cannot be ascribed to variations in number of nuclei or in content of DNA or RNA. The effectiveness of various post-irradiation and post-decay treatments in preventing inactivation varies for each strain. With the exception of reactivation by light, strain B/r is less reactivable than B and B_s. The strains do not differ in their rates of mutation to resistance to bacteriophage T_1. However, the rates of mutation of the B_s mutants to the first step of furacin-resistance are considerably lower than the rate for the parent strain B. From one of the B_s mutants, new strains were obtained whose properties are mixtures of those of B and B/r. (auth)

16207 CHANGES IN THE NERVOUS SYSTEM AND INTERNAL ORGANS AT REMOTE PERIODS FOLLOWING RADIUM THERAPY. L. M. Omel'yanenko and M. A. Merkova (Central Inst. for Advanced Training of Physicians, USSR). Med. Radiol., 7: No. 3, 8-13(Mar. 1962). (In Russian)

Results of a dynamic investigation of some patients who, 5, 10, and 20 years ago, had been subjected to radium therapy for different growths are given. It is demonstrated that in immediate as well as in remote periods after radium therapy in these patients there could be found changes in the state of the nervous system, hematopoietic, internal, and other organs. The degree and frequency of postirradiation changes depend, to a great extent, upon the localization of the irradiation fields, the dose, and the individual specific features of the organism. (auth)

16208 CHANGES IN THE CARDIOVASCULAR SYSTEM ASSOCIATED WITH RADIUM THERAPY IN PATIENTS SUFFERING FROM CANCER OF THE ESOPHAGUS. I. T. Abasov and Sh. M. Beibutov (Azerbaydzhan Inst. of Roentgenology and Radiology). Med. Radiol., 7: No. 3, 13-19 (Mar. 1962). (In Russian)

Patients affected with cancer of the esophagus were treated with radium therapy. Complex investigation of the cardiovascular system demonstrated that the radiotherapy in the overwhelming majority of patients does not cause any considerable functional and morphological changes. Cardiovascular changes were not attended by any compensatory disturbances of the cardiovascular activity; there were no congestive manifestations in the greater and lesser circulation. Clinical signs of reduced vascular tone were observed more frequently. In the majority of cases these changes were of transitory nature. (auth)

16209 PHYSIOLOGICAL AND DOSIMETRIC INVESTIGATIONS OF THE INFLUENCE OF PERORAL USE OF RADON WATER ON THE GASTRIC SECRETORY FUNCTION. V. M. Deryabina, M. S. Kagan, L. M. Legen'kaya, E. V. Khurtina (Piatigorsk Scientific Research Inst. of Balneology, USSR). Med. Radiol., 7: No. 3, 39-45(Mar. 1962). (In Russian)

Physiological and dosimetric investigations pertinent to the influence of peroral use of radon water on the secretory function of the stomach were conducted. Single and threefold administration into dogs' stomachs of artificial radon water, the concentration of radon amounting to 5000 units Mache 1.8 μc in 250 ml (the integral absorbed radiation dose 18.7–56.1 rad) did not cause any noticeable shifts in the secretory function of the stomach. A four-week administration of radon water (the dose averaging 1047 rad) produces an intensification of the gastric secretory function and a prolonged aftereffect was noted. (auth)

16210 SEASONAL INFLUENCES ON THE ANTIBIOTIC SENSITIVITY OF INTESTINAL FLORA IN DOGS UNDER A CHRONIC ACTION OF Sr^{90}. O. G. Alekseeva and G. M. L'vitsina. Med. Radiol., 7: No. 3, 58-61(Mar. 1962). (In Russian)

During different seasons of the year the sensitivity of the intestinal microflora to antibiotics in practically healthy dogs is invariable. Changes in the numbers of microbes in the autoflora occurring in practically healthy animals which are carriers of Sr^{90} are accompanied with a changing sensitivity to antibiotics during all the seasons of the year, but with the nature of seasonal fluctuations remaining invariable. (auth)

16211 THE HEALING OF INFECTED WOUNDS IN EXPERIMENTS INVOLVING REPEATED ACTION OF IONIZING RADIATION. A. D. Kazaryan and L. I. Abaskulieva. Med. Radiol., 7: 61-6(Mar. 1962). (In Russian)

Studies were made of the remote repeated action of ionizing radiation on the course of wound processes. The experiments were staged on 37 rabbits, in 19 of which a study was made of the effect of repeated x irradiation (total dose 2,852 r) on the course of an infected wound repeatedly inflicted 6–8 months following the primary irradiation and infliction of infected wounds. The other 18 rabbits served as controls. (auth)

16212 NEUROPATHOLOGICAL EFFECTS OF LOW-LEVEL X-IRRADIATION OF THE MAMMALIAN EMBRYO. Roberts Rugh and Erica Grupp (Columbia Univ., New York). Military Med., 126: 647-64(Sept. 1961).

An exposure of the 1.5 day mouse embryo (at the 1 to 2 cell stage) to as little as 15 r x rays will delay the early cleavages, increase intra-uterine death and resorption, reduce the number of apparently normals at birth, and occasionally cause the severe brain anomaly of exencephalia (brain hernia) indicating morphogenetic damage. When the embryo at 2.5 days (4 to 8 cells) is exposed to the same low level of 15 r x rays there is less severe damage, and exencephalia has never been produced. However, even some of these embryos go to pieces shortly after exposure or at the time of implantation. Cytologically the most common effect on some embryos of 15 r at 1.5 days is fragmentation of the early cleavages, resulting in reduced and a-nucleate blastomeres. Whether such a reduced but nucleated blastomere could give rise to a stunted fetus is mere conjecture. Other effects of 15 r at 1.5 days are swollen or pyknotic nuclei, hyperchromatic nuclei and occasionally the cytoplasm, and sometimes complete separation of constituent cells of the blastula at a later stage. Damaged blastomeres appear to exude a sticky substance which may be denatured cytoplasmic protein. Radiosensitivity of the embryo appears to be greatest immediately after fertilization and becomes progressively less as development proceeds. Until organogenesis is completed, however, embryonic loss may occur through death and resorption as a result of x irradiation and among the others there may be congenital anomalies and stunting which survive delivery. While extrapolation to other mammals is ill-advised, it is certainly suggestive that the radiosensitivity of the very early mammalian embryo may approach that of a genic mutation, and any exposure is too much. (auth)

16213 QUANTITATIVE STUDY OF CHANGES IN ORAL MUCOUS MEMBRANE INDUCED BY DIFFERENT KINDS OF RADIATIONS. L. Marullo and P. G. Paleani. Nuntius Radiol., 27: 989-94(1961).

The reactions of oral mucous membrane to different types of radiation are quantitatively analyzed on the basis of dose-time ratio ($D = K \cdot t_n$). The results obtained, compared with previous investigations carried out on the skin, confirm (for the high energy radiations) a different influence of fractionation on the appearance of mucous membrane reactions. (EURATOM)

16214 SUPERVOLTAGE THERAPY: A REVIEW OF PRESENT DAY FACILITIES AND TECHNIQUES. F. T.

Farmer (Royal Victoria Infirmary, Newcastle-upon-Tyne, Eng.). Phys. in Med. Biol., 6: 505-31(Apr. 1962).

A critical review is given of the principal machines used for high energy therapy, namely the resonant transformer, the 2 Mev Van de Graaff, the cobalt-60 apparatus, the linear accelerator and the main types of betatron. The latter include the Siemens 15 to 17 Mev, the Allis Chalmers 24 Mev, and the Brown Boveri 31 to 35 Mev machines. An attempt is made to compare the performance and therapeutic value of the various types of machine and, within approximate limits, arrive at some estimate of their relative cost in treating, for example, an average patient to a tumor dose of 5000 r. This relative cost depends not only on the initial cost of the machine and building but also on the dose rate and ease of setting up, both of which determine the number of patients that can be treated in a day. Broadly, the cost per patient is about the same for the linear accelerator and cobalt units while that for the betatron (using x rays) appears to be considerably higher, largely due to its relatively low output of x rays. Electron therapy, for which the betatron is admirably suited, has attractive features and the physical characteristics of this form of treatment are discussed. References are given to the principal works on the physical aspects of supervoltage therapy. (63 references.) (auth)

16215 NEUTRON PENETRATION DURING NEUTRON CAPTURE THERAPY. Norman A. Frigerio (Argonne National Lab., Ill.). Phys. in Med. Biol., 6: 541-9(Apr. 1962).

Neutron transport theory has been applied to the problem of penetration of a broad beam of neutrons into finite and semi-infinite volumes of aqueous media. The expressions derived are in excellent agreement with data obtained using a human head phantom of tissue equivalent gel. Epithermal neutrons proved to be much more penetrating than thermal neutrons and thus more advantageous for neutron capture therapy. The presence of 0.02% boron in the gel further increased the advantage of epithermal neutrons while diminishing their flux only slightly. (auth)

16216 EXPOSURE DOSE MEASUREMENTS IN MEGAVOLTAGE THERAPY. D. Greene, J. B. Massey, and W. J. Meredith (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Phys. in Med. Biol., 6: 551-60(Apr. 1962).

Arguments are presented to show that an ionization chamber in a scattering medium measures the exposure dose at its own center provided it is at a depth sufficient to be on the exponential part of the depth dose curve. The minimum depth for the establishment of electron equilibrium is defined. This is not in accord with the usual assumption that the equilibrium is established at the depth dose curve maximum, and it is shown that the difference in exposure dose measured according to the two definitions can be as much as 5% for 20 Mv radiations. At 2 Mv the difference is negligibly small. Use of the N.P.L. roentgen calibration factor leads to a statement about the dose at the center of the hole made in the phantom to receive the chamber. The correction factors to be applied to yield the exposure dose at the center of the filled hole are discussed. For 2 Mv radiation the measured factor, which is independent of field size and chamber depth, is 0.991. (auth)

16217 THE CALCULATION OF GAMMA RAY PENETRATION OF THE WALLS OF CYLINDRICAL AND CONICAL COLLIMATING HOLES. H. A. B. Simons (Royal Free Hospital School of Medicine, London). Phys. in Med. Biol., 6: 561-76(Apr. 1962).

The ratio f of quanta from a point source of γ radiation which penetrate the side wall of a collimating hole to those which pass through the exit pupil of the hole has been derived by analytical methods for the cases of a cylindrical and a conical hole. In the case of a cylindrical hole values of f are obtained as a function of μH where μ is the linear absorption coefficient of the material of the collimator and H is the distance of the source from its lower plane. It is shown that for a constant value of H, the value of f is constant for all points lying within the projection of the collimating hole. The formulae given apply to any cylindrical hole within the limits of the approximations made in their derivation. The formulae for focusing collimators, where the holes are truncated cones, are derived for axial point sources only, and it is shown that the value of f is smaller in this case than for the equivalent situation with a cylindrical hole. (auth)

16218 A STUDY OF THE RELATIONSHIP BETWEEN X-RAY DOSE DELIVERED TO THE THYROIDS OF CHILDREN AND THE SUBSEQUENT DEVELOPMENT OF MALIGNANT TUMOURS. S. A. Beach and G. W. Dolphin (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Phys. in Med. Biol., 6: 583-98(Apr. 1962). (AHSB(RP)R-13)

Three recent surveys of the incidence of thyroid tumors in persons given certain types of radiation treatment in childhood which delivered some dose to the thyroid are analyzed. These surveys contain a total of 4673 irradiated children and record the subsequent development of 23 malignant and 16 non-malignant thyroid tumors. A literature search produced information about a total of 132 malignant thyroid tumors in persons who had received a dose of radiation to the thyroid in childhood. The distribution of the latent periods of these tumor cases was used to predict the total number of tumor cases to be expected in the three surveys. A quantitative dose-response relationship is discussed and compared with others given in the literature. Assuming a linear relationship the data analyzed here suggest an approximate incidence of 1.7% per 500 rads for malignant tumors. (auth)

16219 THE EFFECTS OF X-IRRADIATION ON THE ENZYMATIC ACTIVITY OF NUCLEAR DPN-PYROPHOSPHORYLASE. S. J. Adelstein and S. L. Biggs (Harvard Medical School, Boston). Radiation Research, 16: 422-31 (Apr. 1962).

The DPN-pyrophosphorylase activity of rat thymus and liver nuclei was determined in normal animals and in those receiving 900 rads of total-body x irradiation. The specific enzymatic activity was higher in liver than in thymus nuclei, but the Michaelis constants were the same for both NMN and ATP substrates. The total-body irradiation did not affect the enzymatic activity or the Michaelis constants in either liver or thymus. In the days after irradiation there was a striking increase in the enzyme activity of thymus nuclei, probably due to a change in the cell population. X irradiation of isolated thymus nuclei up to 120,000 rads did not affect the DPN-pyrophosphorylase activity, nor did x irradiation lead to release of the enzyme from the isolated nuclei. However, x irradiation of the nuclear suspensions consistently resulted in a better preservation of enzyme activity in nuclei kept at 5°C for 1 to 4 days after isolation. A partially purified DNA-free preparation of DPN-pyrophosphorylase was obtained from rat liver nuclei. At a dilution which had the same activity per milliliter as the isolated nuclear suspension, the preparation had a D_{37} of 80,000 rads. (auth)

16220 THE RADIOSENSITIVITY OF *ESCHERICHIA COLI* AND *STREPTOCOCCUS FAECALIS* AS INFLUENCED BY VITAMIN K_5 AND ITS ANALOGS. G. J. Silverman, A. M. El-Tabey Shehata, and S. A. Goldblith (Massachusetts Inst. of Tech., Cambridge). Radiation Research, 16: 432-40(Apr. 1962).

Six compounds structurally related to and including vitamin K_5 were examined for their ability to increase the lethal effects of γ-radiation on *E. coli* and *S. faecalis*. Two compounds, 4-amino-1-naphthol and 1-amino-2-naphthol, increased the lethal effects of ionizing energy to a greater extent than vitamin K_5 for both test organisms. All three compounds were most effective against *E. coli* only in the absence of oxygen. In contrast to this, *S. faecalis* was influenced both in the presence and in the absence of oxygen, although, in general, to a greater extent in its absence. In addition, menadione sodium bisulfite and 5-amino-1-naphthol were active against *S. faecalis* irradiated in a nitrogen atmosphere. The presence of the methyl group in vitamin K_5 is apparently responsible for this compound's being less effective than 4-amino-1-naphthol, and shifting the amino group to the adjacent ring in amino naphthol decreased or eliminated synergism. The implications of whether or not these compounds are exerting true enhancing or sensitizing mechanisms or a combination of these effects are discussed. (auth)

16221 EFFECTS OF PRENATAL X-IRRADIATION ON ACTIVITY, EMOTIONALITY, AND MAZE-LEARNING ABILITY IN THE RAT. Jack Werboff, Joan Havlena, and Melvin R. Sikov (Wayne State Univ., Detroit). Radiation Research, 16: 441-52(Apr. 1962).

Gravid albino rats of the Sprague-Dawley strain received 25, 50, or 100 r of whole-body x irradiation on either day 5, 10, 15, or 20 of gestation. Controls were sham-irradiated. Offspring were evaluated for activity and emotionality on the inclined-plane and open-field test and for maze-learning ability on the Lashley III maze. The results show that prenatal radiation exposure alters activity, emotionality, and learning ability as measured by these tests. On the inclined-plane test, a generalized depression of activity was observed, with a more pronounced effect seen in groups irradiated late in gestation. On the open-field test, activity of the early irradiated groups continued to be depressed, with an increase in activity observed in the late irradiated groups. Emotionality was generally reduced in most radiation groups. Dose-response relationships were not consistently evident. On the maze-learning test, the female offspring that were irradiated early (day 5 or 10) during fetal development learned the maze faster, whereas female offspring receiving radiation later (day 15 or 20) during fetal development showed adverse effects. For male offspring, there were no clear dose-response or stage-dependent effects, with radiation groups in general showing a facilitation in maze-learning ability as compared to the controls. These results are discussed with reference to previous findings in this area, and various biological mechanisms are presented to account for these data. (auth)

16222 THE MECHANISM OF RADIATION-INDUCED EXTRACHROMOSOMAL MUTATION. Allen P. James (Atomic Energy of Canada Ltd., Chalk River, Ont.). Radiation Research, 16: 453-63(Apr. 1962).

The mechanism by which ultraviolet light induces extrachromosomal mutations has been studied by using the character of respiratory sufficiency versus deficiency in an unstable strain of yeast. It has been possible to differentiate between cells on the basis of the relative numbers of particles which they contain. Data have indicated that the assortment of particles is not more erratic than usual in the first postirradiation cell division, ultraviolet light usually acts to decrease particle concentration in descendants of irradiated cells, but in some cells it acts to increase the concentration, and particle concentration is less reduced in the descendants of the first bud of an irradiated cell than in the descendants of subsequent buds. Irradiation-induced extrachromosomal mutation is discussed in terms of an alteration of the cytoplasm which is prolonged through at least one cell generation and which is conducive to the temporary or permanent inability of the particles to reproduce. (auth)

16223 SOME OBSERVATIONS ON IRRADIATION EFFECTS IN YEAST. H. Laser (Cambridge Univ., Eng.). Radiation Research, 16: 471-82(Apr. 1962).

Two strains of yeast, a haploid and a diploid one, were irradiated with x rays, and survival curves were obtained by colony counts. In haploid yeast, the viability decreased exponentially with increasing x-ray dose, whereas the diploid strain exhibited a plateau in the dose-response curve similar to that previously described by other workers for haploid yeast. The number of survivals and the shape of the survival curves varied with the physiological condition of the cells at the moment of irradiation. Thus, for example, in baker's yeast, deprivation of a source of nitrogen prior to irradiation resulted in a certain degree of protection, when compared with the survival of fresh nonstarved cells. Considerable protection was further afforded in both strains of yeast if cells were grown and irradiated in high concentration of substrate (55% fructose). Lastly, nitrogen deprivation interposed between irradiation and plating also favored recovery. Reasons are suggested for these changes in support of the view that indirect effects of irradiation contribute to a large extent to loss of viability in yeast. (auth)

16224 RELATIVE RADIOSENSITIVITY OF DIFFERENT PHASES IN THE LIFE CYCLE OF L-P59 MOUSE FIBROBLASTS AND ASCITES TUMOR CELLS. W. C. Dewey and R. M. Humphrey (Univ. of Texas, M. D. Anderson Hospital and Tumor Inst., Houston). Radiation Research, 16: 503-30 (Apr. 1962).

The radiosensitivity of different stages in the life cycle of mouse L cells growing *in vitro*, and mouse ascites tumor cells growing both *in vivo* and *in vitro*, was determined by analyzing the *cells* for chromosomal damage at anaphase during the first division postirradiation. For the L cells the effect of irradiation on different stages of the life cycle was also studied in terms of cell multiplication and mitotic delay. Data are presented graphically. (auth)

16225 GENETIC EFFECTS IN POPULATIONS WITH SPECIAL REFERENCE TO STUDIES IN MAN, INCLUDING ABCC RESULTS. Howard B. Newcombe (Atomic Energy of Canada Ltd., Chalk River, Ont.). Radiation Research, 16: 531-45(Apr. 1962).

The results of human population surveys bearing on the possible genetic effects of radiation exposure are reviewed, including data obtained by the Atomic Bomb Casualty Commission from studies in Japan. Relevant kinds of information have been derived from both irradiated and unirradiated populations. The possible designs of future surveys are considered with a view to achieving a higher order of precision than has been possible in the past. Such precision must depend, in part, on an increased availability of family reproductive and mortality data of certain specific sorts. An important component of the needed information already exists, accurately recorded and virtually complete for large populations, but in a form that renders it largely inaccessible to scientific study. Attention must now be directed to the technical and organizational problems of extracting this information in an appropriate and usable form. (auth)

16226 INFLUENCE OF PRE- AND POST-X-IRRADIATION ZYMOSAN ADMINISTRATION ON RETICULOENDOTHELIAL FUNCTION. W. R. Wooles, E. E. Elko, and N. R. Di Luzio (Univ. of Tennessee, Memphis). Radiation Research, 16: 546-54(Apr. 1962).

Phagocytic activity, evaluated by the intravascular removal rate of colloidal carbon, was determined in mice injected with the reticuloendothelial (RE) stimulating agent, trypsinized zymosan, either prior to or immediately after exposure to 1000 r. Half-times (t/2), global phagocytic activity, corrected phagocytic activity, and weight changes of liver and spleen were determined at frequent postirradiation intervals. The hyperphagocytic state induced by the injection of zymosan was unaltered after radiation exposure. Phagocytic function was significantly impaired in normal mice 96 hours after exposure. In contrast, the injection of zymosan after exposure maintained normal RE function but did not induce a hyperfunctional state. Survival to various doses of x irradiation was unaltered by zymosan-induced RE stimulation. (auth)

16227 ACUTE BRONCHOPULMONARY DISEASE DURING RADIOTHERAPEUTIC TREATMENT, WITH SPECIAL REGARD TO TELECOBALTOTHERAPY. Q. Falchi and G. Valpreda (Università, Genoa). Radiol. Med., 48: 37-51 (Jan. 1962). (In Italian)

After considering the results of previous studies on bronchopneumonia secondary to roentgenotherapy of the thorax, the authors report their observations relative to 48 cases treated with fixed field roentgenotherapy for operated mammary neoplasms and to 145 patients suffering from neoplasms of the thorax and treated with fixed field telecobaltotherapy. They point out the very low incidence of acute symptoms after telecobaltotherapy, compared with all other forms of roentgenotherapy previously used, and in spite of the high doses and the large extension of the fields sometimes used. (54 references.) (auth)

16228 RADIOLOGIC LIFE SHORTENING, SENESCENCE, AND CARCINOGENESIS. Paul S. Henshaw (Div. of Biology and Medicine, AEC, Washington, D. C.). Radiology, 78: 523-9(Apr. 1962).

The concept that radiological life shortening, senescence, and carcinogenesis have a common origin is discussed. Recent data are reviewed that substantiate this concept. (C.H.)

16229 DISTRIBUTION OF RADIATION ENERGY IN THE CELL. H. H. Rossi (Columbia Univ., New York). Radiology, 78: 530-5(Apr. 1962).

The fact that inactivation of mammalian cells by ionizing radiation of high linear energy transfer (LET) is exponential and subject to little or no recovery, while inactivation by low LET is sigmoid with extensive recovery, has led to the conclusion that the former type of radiation inactivates in single events while the latter does so in multiple events. It is pointed out that numerical information is needed on how energy is distributed on a microscopic scale. A parameter, given the symbol Z, for this purpose is defined which represents the energy absorbed per unit mass in small spherical volumes within the irradiated tissue. The relation between dose and Z is discussed. It is pointed out that one will find a wide spectrum of Z values, which may range from zero to a figure very much greater than the absorbed dose. Techniques for the measurement of such spectra are described. (C.H.)

16230 THE FLUID-FLOW THEORY AND INDIRECT ACTION OF RADIATION. Titus C. Evans (State Univ. of Iowa, Iowa City). Radiology, 78: 536-43(Apr. 1962).

Preliminary findings with mouse ascites tumor cells irradiated in vitro are presented that indicate possible indirect radiation effects transmitted through the medium surrounding cells. These observations offer an explanation through fluid-flow theory as to the mechanisms of indirect radiation effects on cells. Findings are also presented which may be interpreted as indicating that the action of radiation on cell membrane leading to cytolysis may not be solely an indirect one, through the medium, but has to do with immediate survival rather than to nuclear damage, the effects of which become apparent later. Criteria for indirect effects of radiation on cells are presented. (C.H.)

16231 BRAIN TUMOR LOCALIZATION UTILIZING MERCURY 203. Millard N. Croll, Luther W. Brady, and R. Marvin Hand (Hahnemann Medical Coll., Philadelphia). Radiology, 78: 635-7(Apr. 1962).

It is our impression that Hg^{203} Neohydrin has both physical and biological advantages as a material for cerebral scintillation scanning. These advantages are reflected in improved scans. The significantly shorter biological half life results in considerably less total-body radiation dose to the patient. (auth)

16232 NEW TESTS ON THE RADIATION EFFECTS ON THE CALCIUM ASSIMILATION IN BONE. Adolf Zuppinger and Walter Minder (Universität und des Inselspitals, Bern). Strahlentherapie, 117: 63-71(Jan. 1962). (In German)

The incorporation of calcium into bones shows a fast exchangeable calcium portion with a mean stay of 4 days and a slow exchangeable portion with a mean stay of 36 weeks or longer. The incorporation of Ca^{45} into bone mineral is disturbed in the fast exchangeable exterior crystal portion by ionizing radiation, depending upon the dose. This disturbance can be expressed by a simple exponential function. The disturbance of incorporation approaches a limit value of 36% after 14 days, a limit value of 50% after 6 weeks for the highest administered dose, using a single application. The fast exchangeable calcium turn over in the living bone occurs most probably by action of the bone cells. A very significant influence of the time factor can be shown by changing the dose rate from 150 to 50 r/min using conventional radiation as well as 30-Mev-electrons. (auth)

16233 STUDY ON THE BEGINNING OF THYMUS ATROPHY AFTER RÖNTGEN IRRADIATION. III. THE BINDING BETWEEN DEOXYRIBONUCLEIC ACID AND PROTEIN IN RADIATION DAMAGE OF TELL NUCLEI. Ulrich Hagen (Universität, Freiburg i. B. and Heiligenberg-Institute, Ger.). Strahlentherapie, 117: 119-28(Jan. 1962).

The bonds between deoxyribonucleic acid and protein are loosened or destroyed in the nuclei of the thymus cells of rats after a whole-body irradiation. This radiation effect can be seen even before cell death, during the second hour after irradiation. By determination of certain nucleoprotein preparations before and after a whole-body irradiation it was found that this binding, which is damaged by irradiation is very important for the maintenance of chromosome structures. The radiation effect is erased, if calcium-ions are added to the damaged nucleoprotein. The amount of the calcium-ions, necessary, is proportional to the radiation dose. It is possible that calcium causes a reunion of the loosened bindings between DNA and protein. (auth)

16234 TO THE QUESTION OF ACTION OF IONIZING RADIATION AFTER PREVIOUS HYPOXIA ON THE EXAMPLE OF THE RAT. Heribert Braun and Konrad Ammon (Universitätsklinik Würzburg, Ger.). Strahlentherapie, 117: 129-33(Jan. 1962). (In German)

Hypoxia lasting throughout the duration of irradiation has a protective effect against ionizing radiation like undercooled tissue. Experiments were done, in which rats were kept in an oxygen-deficiency for a longer period of time to find out if this has an influence on response to subsequent whole-body irradiation with x rays. It was observed, that the hypoxia represents an additional stress, which results in an increased mortality of the animals. This effect is associated with a disturbed metabolism of the organism, a situation which has a lethal result because of its complete disorganization. (auth)

16235 MORPHOLOGY OF EARLY CHANGES IN THE CYTOPLASM OF LIVER CELLS AFTER IRRADIATION. Hildegard Braun (Universität, Freiburg i. B. *and* Heiligenberg-Instituts, Ger.). Strahlentherapie, 117: 134-41(Jan. 1962). (In German)

Electron microscopic investigations of early changes in the cytoplasm of liver cells were done in mice irradiated with 150, 300, and 450 r and rats irradiated with 800, 3200, 6400, and 9600 r 30 min. after whole-body x irradiation. A decrease in the ergastoplasmatic lamellae was shown for all doses; increasing doses caused an increasing vacuolization of the remaining cavities. The basic structure of the cytoplasm condenses and, at the same time, above 3200 r, vacuoles are formed. Mitochondria show a tendency to form clods during all experiments and lie, preferably, at nucleus and cell membrane. This reaction is less distinct at 9600 r. Destructions of the internal structure of mitochondria begin to appear at 3200 r. The mitochondria start swelling and the cristae are degraded at 6400 r. Increased lipid bodies in the plasma and dark enclosures in the vacuoles appear. (auth)

16236 RADIATION CANCER AFTER HEMANGIOMA TREATMENT. Jaromír Kolár, Radko Vrabec, and Zdenek Král (Charles Univ., Prague). Strahlentherapie, 117: 147-55(Jan. 1962). (In German)

On grounds of increased possibility to observe x-ray damages in patient material during the past years, with reference to the unusualness of cancer formation after hemangioma treatment during infancy, 5 of our own observations of such complications are described. Four were the result following an externally carried out radium- and 1 following x-ray radiation, which, in all cases, resulted in chronic skin damage. This skin damage developed into a radiation carcinoma. Through radical removal all patients could, up to the present, be saved. (auth)

16237 HEMATOLOGICAL STUDY ON GUINEA PIGS AFTER INCORPORATION OF RADIONUCLIDES IN HIGH DOSES. I. CHANGES IN THE PERIPHERAL BLOOD PICTURE AFTER APPLICATION OF Sr^{89}, Sr^{90}, Ba^{140}, AND Cs^{137}. Ernst Spode (Institut für Medizin und Biologie, Deutsche Akademie der Wissenschaften, Berlin). Strahlentherapie, 117: 356-69(Mar. 1962). (In German)

Changes in the peripheral blood picture of guinea pigs after the intraperitoneal injection of Sr^{89}, Sr^{90}, Ba^{140}, and Cs^{137} (2.5 μc/g body-weight) are reported. A moderate anemia associated with a marked reticulocytopenia was produced. Moreover, a granulocytopenia and a lymphopenia were observed. Some of the animals showed a granulocytosis during the first few days. A definite thrombocytopenia was shown always. The strongest effect was produced by Sr^{90}; less effective were Ba^{140} and Sr^{89}, and the smallest effect was produced by Cs^{137}. (auth)

16238 IRRADIATION DOSE ESTIMATION BY MEANS OF HEMATOLOGICAL VARIABLES. George M. Krise, Sam Barranco, and Sidney O. Brown (A. & M. Coll. of Texas, College Station). Texas Eng. Exp. Sta. News, 13: 14-17(Mar. 1962).

Applications of hematological data in irradiation dose estimates of populations exposed to a nuclear catastrophe are discussed. Data are presented from preliminary studies in rats exposed to various levels of Co^{60} γ radiation for various lengths of time to accumulate various total doses of γ irradiation. Each two weeks the animals were bled and the average values for red blood count, hemoglobin, white blood cell count, hematocrit, platelets, percent neutrophils, percent lymphocytes, percent monocytes, percent eosinophils, and percent basophils were tabulated against the respective cumulative dose for each animal. Data were analyzed by statistical techniques and computed on an IBM 709 computer. Results are presented graphically. It is concluded that hematological variables may offer a simple, clinical test, available under field conditions, for screening a population and separating them into groups who have received exposure to more than 500 rads and who will die regardless of treatment, those who have received exposure to 200 to 500 rads and who may respond to treatment, and those who have received less than 200 rads and who may be expected to recover. (C.H.)

16239 THE ALTERATION OF TYPE-SPECIFIC MORPHOLOGICAL PROCESSES OF *ACETABULARIA* BY UV IRRADIATION. Guenther Werz and Joachim Haemmerling (Max-Planck-Institut für Meeresbiologie, Wilhelmshaven, Ger.). Z. Naturforsch., 16b, 829-32(Dec. 1961). (In German)

The inhibition of morphogenesis in enucleated cells of *Acetabularia* by UV irradiation is due to a destruction of species-specific morphogenetic substances stored within the cytoplasm. The possible relations to the destruction of cytoplasmic RNA are discussed. (auth)

16240 THE EFFECT OF RADIATION ON *ACETABULARIA*. IV. X-RAY EFFECTS IN DUAL-NUCLEATED TRANSPLANTS. Erich Six and Simone Puiseux-Dao (Max-Planck-Institut für Meeresbiologie, Wilhelmshaven, Ger.). Z. Naturforsch., 16: 832-5(Dec. 1961). (In German)

Grafts made of two x-irradiated nucleated cell parts of *Acetabularia mediterranea* showed about the same dose-dependent reduction of the cap forming ability as previously found for ungrafted uninucleated cell parts. Similar grafts with one irradiated and one unirradiated partner showed no significant reduction of the cap forming ability. Two nucleated interspecies grafts between an irradiated partner and an unirradiated partner, i.e. *A. mediterranea* or *crenulata*, revealed both a dose-dependent and irreversible destruction of the species specific morphogenetic substances stored within the cytoplasm and of the nucleus-dependent production of these substances as judged by the morphology of the caps formed by these grafts. (auth)

16241 SECOND INTERNATIONAL CONGRESS OF NEUROLOGICAL SURGERY OF THE WORLD FEDERATION OF NEUROSURGICAL SOCIETIES, WASHINGTON, D. C., OCTOBER 14-20, 1961. Excerpta Medica International Congress Series No. 36. Abstracts and Descriptions of Contributions to the Scientific Program. Amsterdam, London, Milan, and New York, Excerpta Medica Foundation, [1962]. 789p. (In English, German, French, and Spanish)

Abstracts are presented on some 200 papers covering various aspects of modern neurosurgical practice. Separate abstracts on 11 of these dealing with radioisotopes were prepared for NSA. (C.H.)

16242 BIOLOGICAL EFFECTS OF HEAVY RADIATION PARTICLES. Cornelius A. Tobias (Univ. of California, Berkeley). p.E1-2 of "Second International Congress of Neurological Surgery." Amsterdam, London, Milan, and New York, Excerpta Medica Foundation, [1962]. (In English)

A series of accelerated atomic nuclei has been employed for biomedical studies over the past 12 years. The nuclei include protons at 340 and 700 Mev kinetic energy, α particles at 380 and 900 Mev, deuterons at 190 and 450 Mev, and a series of particles that includes H^1, D^2, B^{10}, C^{12}, N^{14}, O^{16}, Ne^{20}, and Ar^{36}, all at 10 Mev per nucleon. The physical properties of these nuclei, their straight line penetration, well-defined range, Bragg ionization properties, and relatively low rate of scatter allow the use of these rays for producing deep lesions of well-defined boundaries in the central nervous system and elsewhere in the body with relatively small damage in intervening tissues. Applications are discussed in pituitary irradiation for advanced metastatic mammary and prostate cancer, for the treatment of diabetes mellitus with vascular disease, acromegaly, and malignant exophthalmos. (C.H.)

16243 DISRUPTION OF NERVOUS TISSUE BY RADIATION. Webb Haymaker (Ames Research Center, Moffett Field, Calif.). p.E2-3 of "Second International Congress of Neurological Surgery." Amsterdam, London, Milan, and New York, Excerpta Medica Foundation, [1962]. (In English)

Cellular damage is described that was observed in the brain of rats exposed to α particles from a 60-in. cyclotron at brain surface doses of 50 rad up to 12,000 rad. Of particular interest was the early destruction of neuroglia in the Bragg peak area of both the cerebrum and cerebellum. Changes were also noted in circulation and permeability and in glycogen content. There was ample evidence of direct cellular damage induced by the irradiation. (C.H.)

16244 DIAGNOSTIC USE OF GAMMA ENCEPHALOGRAPHY IN NEUROSURGERY. Therese Planiol (Hopital de la Pitié, Paris). p.E4-5 of "Second International Congress of Neurological Surgery." Amsterdam, London, Milan, and New York, Excerpta Medica Foundation, [1962]. (In English)

The results obtained with I^{131}-labeled serum albumin and a surface scintillation counter to determine α activity at various points within the skull are discussed. The value of this method of investigation in the diagnosis of intracranial expanding lesions, its limitations, and sources of error are considered. Results are reviewed from studies in 1800 patients that show that radioisotopes with either angiography or pneumoencephalography permit early detection of expanding lesions and considerably improve the accurate diagnosis of these lesions, as to both location and histology. (C.H.)

16245 THERAPEUTIC USE OF RADIOISOTOPES. Jean Talairach, G. Szikla, P. Tournoux, P. Constans, J. Bancaud, and A. Bonis (St. Anne's Hospital, Paris). p.E5-7 of "Second International Congress of Neurological Surgery." Amsterdam, London, Milan, and New York, Excerpta Medica Foundation, [1962]. (In English)

Therapeutic uses of radioisotopes in functional neurosurgery and the interstitial irradiation of certain cerebral tumors are described. Applications of Au^{198}, usually in the form of wires, and Y^{90} as implantations are discussed in detail. Since yttrium is opaque to x rays, its position can be easily assessed. Yttrium implantation is well tolerated by aged and arteriosclerotic subjects, and emits pure β rays which are rapidly absorbed in a few mm of water or in soft tissue. This results in easy use and protection and a well circumscribed zone of necrosis. In 280 applications no immediate or delayed complications directly connected with radioactivity were observed. When large volumes of tissue were to be irradiated Au^{198} wires were mainly used. These are radioopaque, have high activity, and a short half-life and offer easier protection than is possible with Co^{60} or Ra. Results are summarized for a variety of brain lesions treated with radiation sources prepared from these and other radioisotopes. (C.H.)

16246 CEREBRAL RADIOSURGERY. Lars Leksell (Serafimerlasarettet, Stockholm). p.E7-8 of "Second International Congress of Neurological Surgery." Amsterdam, London, Milan, and New York, Excerpta Medica Foundation, [1962]. (In English)

The use of stereotactically directed beams of ionizing radiation for the section of cerebral fiber tracts and destruction of deeply seated nuclei in the brain is discussed. A technique is described for precise cross-firing of the brain target with narrow proton beams. Clinical results are reported for a small group of patients with interactable pain, psychic disorders, and Parkinsonism. (C.H.)

16247 RADIOACTIVE COLLIMATED LOCALIZATION OF INTRACRANIAL LESIONS COMPARED TO CONVENTIONAL NEURORADIOLOGICAL METHODS. Giovanni Di Chiro and G. Milton Shy (National Inst. of Neurological Diseases and Blindness, Bethesda, Md.). p.E69 of "Second International Congress of Neurological Surgery." Amsterdam, London, Milan, and New York, Excerpta Medica Foundation, [1962]. (In English)

Results are summarized for 698 patients suspected of having brain tumors and scanned with collimated scintillation detectors after the administration of I^{131}-labeled serum albumin. Verification either at surgery, autopsy, or by pathognomonic neuroradiological findings are reported for 176 cases. Results are compared with those obtained using conventional neuroradiological methods. (C.H.)

16248 THE USE OF THE BRAGG PEAK OF A PROTON BEAM FOR INTRACEREBRAL LESIONS. Raymond N. Kjellberg and William M. Preston (Massachusetts General Hospital, Boston). p.E103-4 of "Second International Congress of Neurological Surgery." Amsterdam, London, Milan, and New York, Excerpta Medica Foundation, [1962]. (In English)

Brain lesions in cats and monkeys were induced by exposure to the Bragg peak of collimated monoenergetic proton beams. A stereotactic system was devised to deliver doses of from 1,000 to 40,000 rads to discrete areas. The beam does not penetrate beyond the target and harmful effects in the pre-target portion of its path are reduced by the use of lateral portals of entry. The precision of the method and possible clinical applications are discussed. (C.H.)

16249 RADIOACTIVE BISMUTH (Bi^{206}), ITS BIOLOGICAL BASIS AND RESULTS IN THE LOCALIZATION AND POSSIBLE SPECIFIC DIAGNOSIS OF INTRACRANIAL EXPANDING LESIONS. F. Mundinger (Universitäts-Klinik, Freiburg i. B.). p.E125 of "Second International Congress of Neurological Surgery." Amsterdam, London, Milan, and New York, Excerpta Medica Foundation. [1962]. (In English)

Bismuth-206, a pure γ emitter with a half-life of 6.4 days, was used for the localization of tumors. Tumors showed a differential uptake of Bi^{206} second only to that of kidney and liver. Marked differences in uptake were found in the various types of tumors. Electrophoresis of proteins showed that the fractions of tumors corresponding to the gamma globulin fractions of the serum have the greatest concentration of Bi^{206}. Multiple field scanning and scintigrams of almost 100 patients showed that accurate localization of the pathological focus was possible in 72% of cases. Cerebral tumors were localized correctly in 87.5% of the cases. Glioglastomas and undifferentiated gliomas show the highest uptake of Bi^{206}. (C.H.)

16250 BORON SLOW NEUTRON CAPTURE THERAPY OF OPERATIVELY EXPOSED GLIOMAS. William H. Sweet, Albert H. Soloway, and Gordon L. Brownell (Massachusetts General Hospital, Boston). p.E144-5 of "Second International Congress of Neurological Surgery." Amsterdam, London, Milan, and New York, Excerpta Medica Foundation, [1962]. (In English)

Experiences are summarized in the therapy of operatively exposed gliomas with boron slow neutron capture techniques. Since the radiation energy liberated when an atom of B^{10} captures a slow neutron is confined to the vicinity of the cell containing the original boron atom, a maximal sustained differential concentration of a boron compound in the tumor is needed. Over 130 boron compounds were systhesized and tested for toxicity and concentration in tumor tissues. Compounds yielding hopeful preliminary results included trisisopropanolamine borate, p-carboxybenzeneboronic acid, 3-amino-4-carboxylbenzeneboronic acid, m-boronosuccinanilic acid, and sodium perhydrodecaborate. Irradiation procedures are reviewed. Dosage measurements in 8 patients treated after the administration of p-carboxybenzeneboronic acid synthesized with B^{10} show the total radiation dose at the cut cerebral face to be from 1,300 to 4,700 rads for normal brain and 4,030 to 16,000 rads for tumor remnants. (C.H.)

16251 CORRELATIONS OF DOSAGE AND HISTOLOGICAL CHANGES FOLLOWING CEREBRAL IMPLANTATION OF GAMMA EMITTER ISOTOPES. G. Szikla, J. P. Constans, and J. Talairach (Seine Psychiatric Hospitals, Paris). p.E145-6 of "Second International Congress of Neurological Surgery." Amsterdam, London, Milan, and New York, Excerpta Medica Foundation, [1962]. (In English)

Results are summarized of a histological and dosimetric study of late complications following implantation in the brain of 20 to 50 mc of Au^{198} in patients with non-neoplastic disease. Detailed descriptions are included of 3 illustrative cases with different forms of late lesions. Problems of radiation dosimetry in brain irradiation are discussed. (C.H.)

16252 GAMMA-ENCEPHALOGRAPHY WITH BISMUTH 206. H. A. D. Walder and J. Th. van der Werff (St. Radbout and St. Canisius Hospital, Nijmegen, Netherlands). p.E157-8 of "Second International Congress of Neurological Surgery." Amsterdam, London, Milan, and New York, Excerpta Medica Foundation, [1962]. (In English)

The use of Bi^{206} uptake by tumor tissue in the localization and diagnosis of brain tumors is discussed. Techniques of administration and measurement of the isotope are described. (C.H.)

16253 EFFECTS OF IONIZING RADIATION ON THE NERVOUS SYSTEM. Proceedings of the Symposium on the Effects of Ionizing Radiation on the Nervous System; held at Vienna, 5-9 June 1961. (International Atomic Energy Agency, Vienna). Proceedings Series. Feb. 1962. 517p. (STI/PUB/46). $10.00(IAEA).

Proceedings of the Symposium on the Effects of Ionizing Radiation on the Nervous System are presented. Separate abstracts were prepared for 35 of the 36 papers. The remaining paper was previously abstracted for NSA. (M.C.G.)

16254 RADIOBIOLOGY OF NERVOUS RECEPTORS. R. Brinkman (Rijks Univ., Groningen, Netherlands). p.3-11 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

The functional role of membranes, cellular and extracellular, are described, and those membrane properties which may contribute to the explanation of the action of ionizing radiation on excitable tissues, are discussed in more detail. Particular attention is given to the influence of radiation on polarization, ionic permeability and the liberation of neurohormones. Early phenomena of the radiation syndrome, which are likely to be caused by the freeing of neurohormones, are then discussed. Publications demonstrating the radiation sensitivity of photoreceptors are chronologically reviewed. The possible causal significance of the liberation of neurohormones is discussed. (auth)

16255 RADIATION EFFECTS ON ISOLATED NERVES. C. S. Bachofer (Univ. of Notre Dame, Ind.). p.13-26 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

A newly-designed chamber for beta-irradiation of isolated nerves is described. It permits irradiation of small parts of the nerve, or of the total nerve, at dose-rates of up to 10000 rad/min. The arrangement of the beta sources permits uniform bilateral irradiation of the nerve, or, as an alternative, irradiation of the physiological saline solution used to keep the nerve functioning, without irradiation of the nerve itself. Irradiation is possible for any length of time, in a completely controlled environment, without the necessity of moving the nerve in any way whatsoever. This beta irradiator, considerably more versatile than devices employing x rays or gamma rays, was used to supplement information acquired from various isolated nerves irradiated with x rays and with ultraviolet radiation. The superior cervical ganglion of Blanding's turtle, with associated preganglionic and postganglionic trunks, and the median and lateral giant nerve fibres of the earthworm were irradiated in vitro. Various electrophysiological responses were observed before, during, and after irradiation under various physiological conditions. Electrical stimulation was used to evoke propagated impulses, as well as synaptically transmitted impulses. Various parameters of propagated impulses and synaptic potentials were analyzed. Enhancement of activity, attributable to irradiation, rarely observed in most biological investigations of this sort, was followed by deterioration of activity and eventual block, representative of the lethal action of irradiation, commonly observed in most biological investigations. The energy supplied by irradiation did not act synergistically with the stimulus to produce the enhanced response. Possible mechanisms of radiation action and their implications are considered. (auth)

16256 A COMPARISON OF THE EFFECTS OF ULTRAVIOLET AND IONIZING RADIATIONS ON ELECTRICAL CHARACTERISTICS OF NERVE. E. L. Gasteiger and J. R. Daube (Univ. of Rochester, N. Y.). p.27-41 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

From a review of the literature and from original experiments certain parallels were found in the electrical responses of axons and nerve trunks to ultraviolet (UV) and ionizing radiations. In both cases the nerves are blocked by depolarization. This view is substantiated by the appearance of injury potential, decrease in resting potential as measured by bridge and micropuncture techniques and a three-phase alteration of excitability. Usually, as irradiation progresses, the excitability of the nerve undergoes the following changes: increased excitability, decreased excitability, and inexcitability. The first phase was not seen upon irradiating the node of Ranvier of frog nerve or the squid giant axon with UV. However, upon irradiating the internode, Hutton-Rudolph showed that damage to the myelin produces local depolarization and injury currents which increase the excitability of the adjacent nodes. A similar transient increase of excitability was seen at the margins of, but not in, the UV-irradiated segment of squid giant axons. In response to beta and UV irradiation the action potential decreased along a sigmoidal survival curve leaving at time of block an unaltered positive phase (positive after potential) in the case of UV-irradiated squid giant axons. Only occasionally was there a transient increase in the potential as reported for UV and x irradiation by Bachofer. Reversibility of early responses to irradiation was previously reported, but UV studies of squid and crayfish giant axons showed no reversals, even though a particular effort was made to reveal them. The mechanisms for these changes are yet unknown. The early modification of the rising slope of the action potential and radioactive tracer studies indicate that the Na^+ permeability is first to be altered by either UV or ionizing radiations. On the basis of the greater effectiveness and absorption of UV at a wavelength of 280 mμ, it was suggested that membrane protein has a role in these changes. (auth)

16257 INCREASED RESPONSE OF THE FROG NERVE-MUSCLE PREPARATION FOLLOWING X-IRRADIATION. K. B. Dawson and D. Rosen (Royal Cancer Hospital, London). p.43-50 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

A standard kymograph apparatus was used to study the contraction of the gastrocnemius muscle of the frog (Rana temporaria) when the sciatic nerve was given sub-maximal electric stimuli through platinum wire electrodes, before, during, and after irradiation by 50 kv x rays, delivered at rates of up to 100 kr/min. On irradiation with doses of the order of 20 kr there was an increased response from the preparation. The effect was found on irradiation of the nerve alone, but not on irradiation of the muscle alone; and the region of the nerve over the cathode was the part of the preparation most sensitive to irradiation. The responses of the preparation increased within 5 sec of commencement of irradiation, continued to increase after the irradiation had finished, but then started to fall after the preparation had responded a few times. In the absence of stimulation the radiation effect could be stored for at least 90 min; the effect depended on the functional activity of the preparation, but not solely on the number of impulses carried by the nerve. The size of the effect and the storage of it were dependent on temperature. (auth)

16258 PRESYNAPTIC FAILURE OF NEUROMUSCULAR PROPAGATION AFTER X-IRRADIATION. N. Allen and J. G. Nicholls (Oxford Univ.). p.51-61 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

Mammalian nerve and muscle are relatively resistant to the action of x rays; more than 150 kr are needed to reduce the resting potential of muscle and even larger doses to block conduction in nerve trunks. The process of neuromuscular transmission is however more vulnerable. In the isolated rat diaphragm doses of 115 to 150 kr cause block after 1 to 6 hr; smaller doses (86 kr) have little or no effect even after 27 hr. During block, the action potential recorded from the phrenic nerve is unchanged in size but it no longer initiates an end-plate potential in the muscle. This failure is not due to a decrease in the sensitivity of the end-plate to acetylcholine or to a breakdown of the mechanism of acetylcholine release (such as would be produced by curare or Botulinium toxin respectively) because spontaneous miniature end-plate potentials of normal size and frequency can still be recorded. The block is therefore presynaptic in origin and probably occurs in the fine branches of the motor nerve fibres within the muscle. Increasing the potassium concentration still causes a great increase in the frequency of miniature end-plate potentials; hence the block is probably not due to a dissociation of the normal coupling between membrane potential and acetylcholine release, but rather to a block of impulse propagation in the fine nerve branches. No changes were found in the properties of the muscle membrane or of the contractile system during irradiation, or for several hours after transmission was completely blocked. The amplitude and time courses of miniature end-plate potentials were not changed even after 150 kr or more, and this suggests that the resistance and capacity of the muscle membrane, as well as acetylcholine release, may be unaffected by these doses. There is as yet no explanation for the differential sensitivity of the fine nerve branches to irradiation. (auth)

16259 X-RAY INDUCTION OF ELECTRORETINOGRAM. C. S. Bachofer (Univ. of Notre Dame, Ind.). p.63-73 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

Electroretinal responses of the intact eye of the grass frog to bursts of x rays ranging from single flashes of less than 0.1 r to doses as high as 10^6 r, are considered. Techniques for delivering brief flashes of x rays of very high intensity in conjunction with, or independently of, flashes of light, were developed. It is thus possible to make a comparison between the response to x rays and the response to light, either unmodified or modified by exposure to x rays. The form of the electroretinogram in response to x rays closely resembles that in response to light at low and intermediate intensities, whereas at high intensities distinct differences are noted. The ability of the retina to respond to multiple x-ray flashes is considered. The physical condition of the animal is shown to exert considerable influence on the response to x rays and to light. Evidence is presented to suggest that the response to x rays is attributable to the action of x rays on the pigment of the rods, rhodopsin, and that the cones do not respond to x rays. (auth)

16260 EEG CHANGES FOLLOWING IRRADIATION OF BRAIN TUMOURS. C. H. Håkansson and M. Lindgren (University Hospital, Lund, Sweden). p.77-84 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

Some 40 patients suffering from cerebral tumors (glioblastoma, astro-cytoma, oligodendroglioma, medulloblastoma and metastases) were treated with x rays and their EEG's (electroencephalographs) were recorded before and during the treatment. In all curves the content of slow waves diminished or disappeared during the first half of the treatment. Parallel to this an increase of the α-content was noticed. Later, progress followed one of two tendencies, the typical course of a medulloblastoma with completely normalizing EEG, or that of a glioblastoma with slow waves and other abnormalities reappearing during the treatment. The findings appeared to indicate a disappearance of edema around the tumor in the first phase of the treatment. The normalized EEG's seemed to show a real influence of x rays on the tumor tissue. This coincides with experience from pathohistological examinations. (auth)

16261 CHANGES IN VENTRAL ROOT POTENTIALS DURING X-IRRADIATION OF THE SPINAL CORD IN THE CAT. J. R. Lott (North Texas State Univ., Denton, Tex.). p.85-92 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

Intact cats anesthetized with 30-mg/kg sodium pentobarbital intraperitoneally, were used in experiments. Laminectomy was performed at the level of the last lumbar and the first sacral spinal segments to expose homolateral dorsal and ventral roots of the seventh lumbar segment. A pair of silver stimulating electrodes were placed under the dorsal roots. Recording electrodes, spaced 1.5 cm apart, were placed under the ventral roots. The preparations were covered with paraffin oil to the depth of about 1 cm in order to help maintain the cord and its roots at a relatively constant temperature for long periods of time. Stimulation of the dorsal roots once every 30 s, and recording the ventral root potentials before, during, and following irradiation, were performed by standard electrophysiological apparatus. The stimulus intensity used in most cases supramaximal for the A fibres. The stimulus duration was 0.1 msec. X-irradiation was delivered to the cord at the calculated dose-rate of 336 r/min for 15 min from a beryllium window unit (120 kVp 5 ma). Following stimulation of the dorsal roots, recordings of the ventral root potentials were taken from both cut and intact fibres. During irradiation of the cord, it was found that the amplitude of the monosynaptic potentials from cut ventral roots decreased slightly; however, several smaller polysynaptic fibre discharges became apparent in every case. Tracings of the potentials from intact ventral fibres during irradiation showed amplitude and frequency changes in both the monosynaptic and the polysynaptic discharges. These results clearly indicated that irradiation at relatively low dose-rates may effect an alteration in synaptic pathways within the spinal cord. (auth)

16262 DELAYED RADIATION EFFECTS ON NEURONAL ACTIVITY IN THE SPINAL CORD OF THE CAT. M. Sato, G. M. Austin, and W. R. Stahl (Univ. of Oregon, Portland). p.93-110 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

Results are reported on recent experiments with 35 cats which were studied by glass microelectrode recording of intra- and extra-cellular potentials from spinal motoneurons. Under light anaesthesia, the fifth and sixth lumbar spinal segments were exposed to doses of 3 to 8 kr of 140 kV x radiation. One day to four weeks later spinal preparations were made from these animals. Clinically the animals showed minimal evidence of injury by 4 weeks. Electrophysiological alterations were observed consistently within 2 to 4 days after 5 to 8 kr, and became more pronounced over 4 weeks. They consisted in an increase in extra-cellular potentials of motoneurons evoked by antidromic stimulation by a factor of 1.5 to 2 times and the occurrence of repetitive firing in motoneurons stimulated by a single volley through a mono- or polysynaptic pathway. As many as 50% of all cells showed this effect, which was never seen in controls, but may sometimes be observed after spinal transactions. Intra-cellular potentials were normal or slightly reduced. Some abnormality was apparent in 80 to 90% of all cells after doses above 5 kr; following 3 kr the findings were not definitive and hard to replicate. Previous work dealt with changes following acute exposures of decerebrate preparations to doses of 0.5 to 15-kr x rays. On a number of occasions the irradiation was carried out during continuous recording from electrodes within individual neurons. Within 3 hr following exposure to doses of 0.5 kr or higher, 65% of the animals showed an increase in the slope and maximum amplitude of the input-output curve for a monosynaptic reflex. Small increases in the extra-cellular amplitude of antidromically stimulated motoneurons were also noted. The changes were more marked with higher doses in the above range. A progressive neuronal permeability increase, or other more complex mechanisms, such as disturbances in metabolism, vascular injury or synaptic effects due to radiation, may be responsible for the alterations in excitability. (auth)

16263 THE EFFECT OF IONIZING RADIATIONS (COBALT-60) ON THE RESPONSE OF THE VISUAL CORTEX OF THE CAT. M. Etienne and J. M. Posternak (Université, Geneva). p.111-22 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In French)

Twelve cats, fitted with permanent electrodes, had the head, the body, including limbs, or the whole body irradiated with gamma rays at 400 to 1600 r from Co^{60}. The response of the visual cortex to electric stimulation of the optic radiations was recorded for all the animals. In some, spontaneous activity of the visual cortex was also recorded. The neurophysiological tests applied revealed temporary modifications in some animals after irradiation. The changes detected were irregular, however, and varied as between one animal and another. (auth)

16264 ACUTE EFFECTS OF X-IRRADIATION ON BRAIN ELECTRICAL ACTIVITY IN CATS AND RABBITS. H. Gangloff (Universität, Munich). p.123-35 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

Changes in brain electrical activity, following low doses of x radiation (400 r, 200 r), were seen in both cats and rabbits having electrodes stereotaxically implanted in various cortical and subcortical areas. One of the most striking effects observed in cats by Gangloff and Haley and now confirmed in rabbits, are spike discharges in the hippocampus, which develop at an early period when no clinical signs of neurological damage or radiation sickness are present. This hippocampal spike activity presents these characteristics: it begins within 30 to 60 min after irradiation and disappears after several days; it is essentially limited to the hippocampal area and does not appear in the cortex; the rate of hippocampal firing depends upon the functional state of mechanisms regulating sleep and wakefulness. It is enhanced during sleep or drowsiness, and reduced or suppressed during arousal periods. As shown in acute rabbit experiments, hippocampal spiking is caused to appear in primarily spike-free animals, and is depressed in animals with pre-irradiation spiking, as shown by a reduction in firing rate already occurring during radiation exposure. This suggests that primary pre-irradiation activity may be an important factor involved in central nervous system reaction to ionizing radiation. No significant alterations in cortical activity, indicating direct radiation effects at the cortical level, could be observed under present experimental conditions, either in cats or rabbits, at the dose level used. (auth)

16265 DESCRIPTION OF CLASSICAL CONDITIONING FACILITIES AND RESEARCH IN PROGRESS ON RADIATION EFFECTS ON BEHAVIOUR AT THE UNIVERSITY OF GEORGIA. L. J. Peacock and W. T. James (Univ. of Georgia, Athens). p.139-43 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

A classical conditioning facility was constructed in the Animal Behavior Laboratory of the Psychology Department of the University of Georgia. A sound-proofed conditioning chamber was equipped to permit the simultaneous recording of salivary secretion, leg flexions, electroencephalograms, heart rate, respiration rate, and general activity during Pavlovian conditioning. Apparatus was arranged for the manual or automatic delivery of stimuli (auditory, visual, and tactile) to dogs within the chamber; re-enforcement of responses is accomplished by the delivery of food or electric shock. All stimuli and responses are recorded on a multi-channel polygraph. A study is under way to investigate the cumulative effects of repeated low-level doses of whole-body gamma radiation on the development and performance of conditioned responses in the dog. Changes in response to the various components of a dynamic stereotype of stimuli will be evaluated by computer-processing of the data obtained. The use of Pavlovian conditioning techniques, reported by various investigators in the USSR to be sensitive to relatively low doses of radiation, together with elaborate statistical analysis, will permit the direct comparison of current studies in the USSR with those made in the United States. It is hoped that certain discrepancies in the findings of the two groups of investigators can be resolved by this study. (auth)

16266 HABITUATION AS A FACTOR IN RADIATION-CONDITIONED BEHAVIOUR. J. Garcia, N. A. Buchwald, B. H. Feder, and C. Wakefield (Long Beach State Coll., Calif.; Univ. of California, Los Angeles; and Long Beach Veterans Administration Hospital, Calif.). p.145-53 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

The use of ionizing radiation as the noxious stimulus in avoidance learning studies provides a sensitive test for radiation effects in rats, mice, cats, and monkeys. Significant effects were obtained with doses as low as 10 r accumulated over a four-hour exposure period to a low-level Co^{60} source. Similar results followed a brief exposure to 7.5 rad of fast neutrons delivered in four minutes. The method is to pair a distinctive stimulus with radiation exposure and subsequently to test for avoidance reactions to this stimulus in the post-irradiation period. However, many animals were exposed to higher doses, yet avoidance reactions were rarely reported. It is assumed that habituation of the animals to the laboratory and to the radiation procedures is a critical prerequisite to establishing radiation conditioning. To test this hypothesis albino rats were divided into habituation and non-habituation groups. The habituated animals were repeatedly subjected to all the handling and confinement irradiation, except that the x-ray machine was operated with a shutter shielding the animals from the rays. The non-habituation group received minimal handling. During conditioning the experimental animals of both groups drank saccharine-flavored water prior to x-ray exposure totalling 100 r. Experimental animals of the habituation groups exhibited a marked decrement in preference for the saccharine when tested in the home cages after irradiation. In contrast, the non-habituation animals drank saccharine readily, as did the control groups which were exposed to similar x-ray doses without conditional pairing of saccharine with exposure. These results confirm the hypothesis. (auth)

16267 BEHAVIOURAL CHANGES AS A FUNCTION OF IONIZING RADIATIONS. W. L. Brown and A. A. McDowell (Univ. of Texas, Austin). p.155-70 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

Changes in behavior following irradiation and changes during irradiation were studied. As a continuation of recent efforts, research was carried out on the effects of radioinduced changes in distractibility and in a narrowing of attention on the behavior of monkeys exposed in the laboratory to gamma-neutron doses and of monkeys exposed at the Nevada Test Site to nuclear radiations. For considering changes in behavior during irradiation, an extension of the research done by Brown, W. Lynn et al., a study on changes in behavior during continuous exposure to radiation, is presented. Recent research findings with the monkeys previously exposed in the laboratory to varying mixed neutron-gamma doses include: a demonstration of significantly greater work decrement for normal, than for previously-irradiated monkeys under conditions of repetitious work, and significantly greater stability of behavior for previously-irradiated than for normal monkeys under conditions of social distraction. Recent research with monkeys previously exposed at the Nevada Test Site showed that: exposure to radiation beforehand significantly accelerates extinction of a previously-learned response; previous radiation exposure slows the rate of response in an instrumental conditioning situation and, at the same time, affords compensation by delimitation of the sample to which the organism responds; on a graded series of dot discriminations, the higher the previous dose of radiation, the less the increase in errors, as the discriminations become empirically more difficult; the higher the previous dose of radiation, the greater the change in free-cage behavior as a function of richness of the physically-accessible environment; and on a peripheral cue-discrimination problem, the higher the previous radiation dose the slower the rate of learning for female monkeys and the faster the rate of learning for male monkeys. The second problem concerned an examination of changes in behavior during continuous exposure to x radiation. Specific end-points were: relation between radiation dose and performance decrement, and effects of continuous exposure for 20 hr on performance rate. Dose-rates were 100 r and 200 r/hr for the experimental groups. Results showed that the irradiated groups differed significantly from each other as well as from the controls. Performance decrement for the subjects irradiated was a linear function of dose-rate over time. (auth)

16268 CHANGES INDUCED IN BRAIN ACTIVITY BY LOW DOSES OF X-IRRADIATION. T. J. Haley (Univ. of California, Los Angeles). p.171-85 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

Contrary to earlier views, the brain is not insensitive to the effects of low doses of ionizing radiation. Alterations in spontaneous and evoked electrical activity were found in cats exposed to 200 and 400 r whole-body x-irradiation or 400 r localized to the head but not to the body. Hippocampal discharges occurred and reached their maximum 3 to 7 hr after irradiation. Such effects did not occur in the body-irradiated animals, suggesting a centrally-mediated phenomenon. In addition decreased reticular formation arousal thresholds were observed, but they also occurred in the body-irradiated group, suggesting a possible peripheral mechanism. These effects were correlated with an increased behavioral alertness in the 400-r group and, although they were present, were not as pronounced in the 200-r group. Specific changes also occurred in thalamic recruiting thresholds. Chronic irradiation at 50 r per week produced only hippocampal spiking, and then only after an accumulative dose of 300 r. Other studies utilizing self-stimulation of the brain by rats also indicate that changes can be induced by ionizing radiation. High lever-pressing rates were obtained from posterior hypothalamic areas, i.e., nucleus arcuatus hypothalami, nucleus dorsomedialis hypothalami and area lateralis hypothalami, in one group of animals prior to irradiation. Highly significant increases in rate were observed in this group on the day of irradiation. Low rates were obtained from the same areas in another group of animals both before and after irradiation. Thus, in each of these instances it is evident that the brain can be affected by doses of ionizing radiation which are not necessarily lethal. However, 3 to 4-r doses of radiation do not produce any of the above effects. (auth)

16269 IRRADIATION, GENETICS AND AGING: BEHAVIOURAL IMPLICATIONS. G. W. Meier (Vanderbilt Univ., Nashville). p.187-96 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

A study was made to estimate the significance of the similarity of the effects of irradiation to those which are attributed to aging; and the additive effects of noxious influences on any behavioral change. Groups of mice (CF/1 and BALB/c, 40 days old; CF/1, 350 days old) were exposed to Co^{60} radiation for 44 days (total: 1000 r). Similar groups served as non-irradiated controls. Four months after irradiation (201 and 451 days of age, respectively) all subjects were tested for discrimination learning. When 275 or 525 days of age these subjects were trained on avoidance conditioning procedures. The groups were differentiated on both tests, although with interactions involving age, irradiation, heredity, and testing conditions. The data corroborated the earlier reports of shortened life-span and confirm the intent of this study: behavioral change can be discerned following both natural- and radiation-induced aging. Moreover, data such as these give clues to the aspects of behavior that may be most cogently measured for the clearest designation of the nature of this behavioral change; conversely, the differential changes with aging and irradiation give clues to the mechanisms involved in these behaviors. (auth)

16270 NEUROLOGICAL SEQUELAE TO LOW-LEVEL X-IRRADIATION OF THE DEVELOPING EMBRYO. R. Rugh (Columbia Univ., New York). p.207-24 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

It was established that 200 r x rays to the embryo during early neurogenesis can cause as many as 48% of the mouse embryos to develop exencephalia or brain hernias. The littermates undoubtedly exhibit neurological damage which is less graphic. It was recently shown that the same anomaly can be produced by 15 r x rays delivered to the early embryo at 1.5 days post-conception, or at the two-cell stage. Thus central nervous system anomalies may follow x irradiation at a time long before the onset of neurogenesis. The same type of anomaly was produced through genetic alterations when either the male or the female mouse was x-irradiated and subsequently mated to normal mice. In the case of the female, such anomalies were also found in the F$_2$ and F$_3$ generations. Thus, genetic and congenital anomalies of a similar nature were produced by x irradiation and at levels of exposure within the diagnostic range. Mammalian embryos which are exposed to as little as 5 r at 0.5 days post-conception (pre-cleavage) showed an increase over the controls of early death and disintegration, some delay in cleavage, increase in post-implantation death and resorption, and, upon cytological analysis, some embryos exhibit hyperchromatic nuclei, unequal staining of the cytoplasm, swelling of the nuclei and/or cytoplasm, separation of the blastomeres, and sticky and lagging chromosomes. Thus, this very early embryo is probably the most vulnerable and radiosensitive of all mammalian cells. (auth)

16271 BEHAVIOURAL MANIFESTATIONS OF THE DELETERIOUS EFFECTS OF PRE-NATAL X-IRRADIATION. S. J. Kaplan (Texas Technological Coll., Lubbock). p.225-43 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

Studies employing maze and operant conditioning apparatus were conducted to ascertain the comparative learning ability of pre-natal irradiated and normal control albino rats. Seven dose levels (10 to 200 r) were administered to various groups of subjects, each group receiving a specified dose on one of ten different gestation days (the first through the 17th). One thousand one hundred and twenty subjects were used. All x irradiation was delivered by a standard x-ray apparatus with parallel tubes run at 180 kVp and 30 mA. Filtration factors, rate of delivery, and target distance varied with the total, single whole-body dose given. Simple conditioning-extinction schedules fail to reflect behavioral deficits in irradiated rats which are reflected in the maze behavior of similarly irradiated subjects. Complex conditioning-extinction-reconditioning schedules reflected differences between irradiated and control animals. Sex differences in maze-learning ability between 90-day-old irradiated rats were found where exposures were as low as 15 r on the 1.5 day of gestation. Control subjects show no such sex difference in maze performance. Four-hundred day-old irradiated animals, shown to be deficient to the controls in maze learning, demonstrated, at the age of 650 days, retention of the learned material to the extent seen in control animals. Procedural differences related to the use of retrace gates, numbers of trials per day, and scoring in maze studies, yielded data which confounded the interpretation of radiation effects upon behavior. The data reported can be interpreted to represent signs of organic brain pathology. Both maze- and operant-conditioning experiments provide evidence of distractibility, perseveration, and lowered motivation. (auth)

16272 INDIRECT FOETAL IRRADIATION EFFECTS IN THE DEVELOPMENT OF BEHAVIOUR. G. W. Meier and D. P. Foshee (Vanderbilt Univ., Nashville). p.245-59 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

A study failed to find, in chicks, any behavioral sequelae to pre-natal x-irradiation (LD$_{50}$). In no instance was the behavior of the experimental groups significantly different from each other or from that of the control group. Although other explanations are available, the unique behavior found by others is plausibly attributable to irradiation effects on the pregnant mammal which, in turn, indirectly affect the fetuses. In many respects, the specific behavior and the relation between the time of irradiation and the severity of the effect listed by other investigators are similar to those found for a lack of oxygen at analogous stages in development. In recent studies, data were gathered on litters born to rats which were exposed to x-irradiation (200 r or 400 r) during the middle of gestation. One-third of the pregnant females were so shielded that only the lateral aspects of the abdomen were exposed; a second third was shielded over the lateral aspects of the abdomen only, and the remaining third was not shielded and thus received the maximal exposure to both females and fetuses. The young were examined and weighed at birth, and at intervals thereafter; when 60 days of age they were started on a battery of conventional behavioral tests. As predicted, maximal effects were seen in the young born to the mothers which had received total-body irradiation, somewhat less in the fetus-shielded young, and significantly less in the fetus-exposed young. These differences were especially obvious in the viability at birth, in the developmental curves, and in the behavior on the battery of tests. The possibility of hormonal-metabolic involvement is definitely indicated. (auth)

16273 THE INFLUENCE OF TOTAL-BODY X-IRRADIATION ON THE 5-HYDROXYTRYPTAMINE CONTENT OF THE BRAIN IN NORMAL RATS. M. Randić, Z. Supek, and Z. Lovasen (Institute "Rudjer Boskovic," Zagreb). p.263-5 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

The content of 5-hydroxytryptamine (5-HT) in the brain of an irradiated animal was determined. Nine hundred roentgen total-body irradiation of rats did not result in any significant change of 5-HT content in the brain either immediately, or 2 or 24 hr after exposure. Preliminary results in adrenalectomized rats indicated a possible role played by the adrenal gland in the metabolism of brain 5-HT. (auth)

16274 AEROBIC AND ANAEROBIC METABOLIC STUDIES OF CNS EXPOSED TO INTERNAL IRRADIATION (P^{32}). E. Egaña (Universidad, Santiago, Chile). p.267-83 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

Comparative metabolic studies in vitro carried out in aerobiosis and anaerobiosis regarding the action of internal irradiation of the CNS (central nervous system) can provide certain information about the mechanisms which alter the metabolism of this structure. This study was made with rats receiving P^{32} (pure β-emitter) intraperitoneally in experiments which represent different dose-rates and total doses of internal irradiation under diverse experimental conditions: a single dose of 125 $\mu c/P^{32}$ 100 g body weight and sacrificed at periods of 2, 6, 12, 24, 48, and 72 hr and 90 to 100 days; treatment twice a week totalling 300 to 350 μc/100 g animal in one month; and four-dose treatment, totalling 500 μc/100 g animal. The levels of the CNS studied are: the brain cortex, diencephalon, hypothalamus, mesencephalon, cerebellum, pons/medulla and spinal cord, and the total encephalon. The metabolic studies in vitro were divided into two groups, according to the gas phase used in the determination: aerobic (O_2 95%/CO_2 5%, or pure O_2) and anaerobic (95% N_2/CO_2 5%). Regarding studies in aerobiosis, it was found that the modifications of the indexes, such as respiration and glucose consumption, have a greater interrelation compared to the one existing between these and the cholineacetylasic activity; stimulation of the synthesis of acetylcholine is observed in experiments with one single dose at 48 hr. In anaerobic studies there does not exist such a marked interrelation between the glycolysis and the cholineacetylasic activity. Which of these two studies better expresses the metabolic alteration of the CNS can be said to depend on the gaseous phase studied; thus in aerobiosis it would be the glucose consumption, and in anaerobiosis possibly the anaerobic glycolysis. (auth)

16275 OBSERVATIONS ON APPEARANCE OF HISTOCHEMICALLY-DEMONSTRABLE GLYCOGEN IN THE RAT BRAIN AS EFFECT OF ALPHA-PARTICLE IRRADIATION. I. Klatzo (National Institutes of Health, Bethesda, Md.), J. Miquel, W. Haymaker, C. Tobias, and L. S. Wolfe. p.285-96 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

The dorsal part of the rat cerebrum and cerebellum was exposed to alpha radiation (12 Mev per nucleon) from the 60-in. Berkeley cyclotron at a brain surface dose of 6000 rad (a Bragg-peak dose of 30000 rad). The dose-rate at the level of the brain surface was 10000 rad/min, or 4×10^9 particles per cm^2 s. The rats were sacrificed at various time-intervals after irradiation; the brains were fixed in Rossman's fluid and the tissue was submitted to histochemical procedures for demonstration of glycogen, including various enzymatic digestions. The first definite appearance of glycogen granules was noted 12 hr after irradiation and it reached its peak at the 48-hr stage. After 2 days there was a progressive reduction in the amount of demonstrable glycogen and it became practically undetectable one month after alpha particle exposure. The glycogen granules were most conspicuous in the cerebral cortex above the "Bragg peak" band of injury. In smaller amounts they were present below this band and, occasionally, also in the underlying white matter. In the cerebellum the granules were scattered mostly in the vicinity of the "Bragg peak" band. Frequently, the granules were clearly located within the cytoplasm of the glial cells, particularly of astrocytes. The observations on glycogen were correlated with changes in vascular permeability tested with the fluorescein-labelled serum protein (FLSP) technique and it was shown that the appearance of glycogen preceded by at least 36 hr the first microscopically detectable extravascular penetration of fluorescein-labelled albumin (FLA). This study demonstrated that the appearance of glycogen represents a very sensitive indicator of radiation effect and should lead to further investigations of the disturbance of carbohydrate metabolism which could provide an insight into the cellular changes on the molecular level. (auth)

16276 HISTOCHEMICAL STUDIES ON MOUSE BRAINS IRRADIATED WITH HIGH ENERGY DEUTERON MICROBEAMS. W. Zeman (Indiana Univ., Bloomington), T. Samorajski, and H. J. Curtis. p.297-308 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (BNL-5546). (In English)

As was shown previously, microbeam (75 μ and 25 μ dia.) irradiations with a dose of 100000 rad and more produce complete direct necrosis of nerve cell bodies with little damage to vascular structures and to glia. Histoenzymatic studies revealed the following findings: oxidative enzymes, such as DPN- and TPN-diaphorase, and succinate dehydrogenase, are not affected by microbeam irradiation unless the cells become necrotic, in which case the activity of these enzymes decreases rapidly. During formation of glial scar tissue, astrocytes showed increased activity of these enzymes. Acid hydrolytic enzymes showed increased activity in the irradiated cells, beginning 7 hr after irradiation and preceding the development of overt cell necrosis. This particularly applies to acid phosphatase and cathepsin type C-like proteases, and probably also to beta-glucuronidase. Alkaline phosphatase was not altered in tissue irradiated with microbeams, but a definite reduction was noted after irradiation under conditions resulting in indirect, i.e. vascular, damage. These changes only occurred if the volume of the tissue irradiated was about $\frac{1}{2}$ to 1 mm dia. It is suggested that these findings indicate activation of lysosomal enzymes to be a factor in the development of direct cellular radiation necrosis. (auth)

16277 MORPHOLOGICAL CHANGES IN THE NERVOUS SYSTEM FOLLOWING EXPOSURE TO IONIZING RADIATION. W. Haymaker (Ames Research Center, Moffett Field, Calif.). p.309-58 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

Developing CNS (central nervous system) cells in late prophase (or post-mitotic phase) are the most radiovulnerable. CNS malformations can be induced at any time from fertilization of the ovum to completion of neutral differentiation. Low-level irradiation of the fetus at a certain time in development may result only in abnormalities in CNS cells and in their arrangement. In the mature CNS the pathological effects of high-dose radiation, both particle and electromagnetic, depend on the volume of tissue irradiated. When the volume of tissue irradiated is relatively large, circulatory disturbances play a primary role in pathogenesis. Variations in the circulatory factor just preceding irradiation, and immediately thereafter, may be highly significant in the wide variation in the incidence of lesions, and in their character. When, on the other hand, small volumes of tissue are irradiated (less than 1 mm dia.), the radiation effects that were observed were in tissue cellular elements alone, including their enzyme systems (e.g., cathepsin type A-like proteolytic enzymes). Under such conditions circulatory disturbances play a secondary role in pathogenesis. In general, the vasculo-astrocytic unit is considered the most radio-vulnerable component of the CNS. The delayed effect in the CNS, mainly in the white matter, following low-dose x or gamma radiation, may be attributable to reduction in mitotic cycling of radiation-injured endothelial cells. The wide range in the nature and severity of the lesions occurring under these conditions is presumably dependent on the degree of damage incurred by the blood-brain-barrier mechanism. Species differences exist in the nature and degree of CNS response to electromagnetic radiation. Previously unpublished data on radiation effects in macaque monkeys, chimpanzees, and burros are included. "Ischemic" spherical lesions were observed in the brain of guinea pigs exposed to cosmic rays in the stratosphere, but their significance is, as yet, unknown. Abscopal effects on the CNS (from body irradiation) include reduction in alkaline phosphatase activity and vascular-oriented lesions attributable to aplastic anaemia. Data on effects on the peripheral nervous system following low-level whole-body irradiation are considered. (auth)

16278 EFFECTS OF IONIZING RADIATION ON THE NEURON SUBSTRUCTURE OF THE SUPRA-OPTIC NUCLEUS IN THE RAT. Z. Fumagalli, A. Santoro, and G. Pisani (Università, Messina, Italy). p.361-5 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In French)

By administering different doses of x rays (100 to 500 to 5000 r focus) to hypothalamic nuclei of intact and hypophysectomized rats, it was demonstrated that doses of 100 to 500 r determine modifications of the neurosecretory activity of the neurons of the supra-optic and paraventricular nuclei. The effect was detectable during the first hours. Return to the normal occurred between 10 to 20 days after irradiation. The results observed with the electronic microscope are presented for animals treated with gamma rays, sacrificed immediately, and 6 hr after the treatment. (auth)

16279 EFFECTS OF X-IRRADIATION ON PURKINJE FIBRES. B. Pillat, P. Heistracher, and O. Kraupp (Universität, Vienna). p.367-73 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

X-irradiation at 50 kv, 25 ma, produced a significant fall in the rate of rise of the action potential on isolated Purkinje fibers of calf and sheep hearts. At the same time there was a decrease in the resting and action potential of the membrane. A slight decrease in frequency and the rate of slow diastolic depolarization of spontaneously-beating preparations were also observed. These changes were well pronounced at total radiation doses between 12 and 20 kr and were, at least to some extent, reversible. The resulting changes and possible mechanism of action are discussed. (auth)

16280 EFFECTS OF IONIZING RADIATIONS ON THE VEGETATIVE NERVOUS SYSTEM. A. V. Lebedinskii (Academy of Medical Sciences, Moscow). p.375-95 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In Russian)

The general physiological aspects of the reaction of the vegetative nervous system to radiation exposure are discussed. The universal systemic character of a functional impairment of the autonomous nervous system which affects all tissues and organs is described. The two different mechanisms by which ionizing radiation can change the functional state of the vegetative nervous system are given: direct reaction of the system (both central and peripheral parts) to irradiation; and secondary change due to the impaired regulatory influence of the irradiated cerebral cortex. Impairment of the synaptic transmission in ganglia and nerve endings is discussed. The neuro-endocrine component of the pathological functional state is described. The consequences of functional changes of the vegetative nervous system are discussed under the following topics: trophic influence of the vegetative innervation, mechanism of adaptation reactions, and homeostatic functions of the vegetative nervous system. Basic experimental data on total and local irradiation are reviewed. (auth)

16281 STUDY OF THE COMPARATIVE RADIOSENSITIVITY OF DIFFERENT PARTS OF THE BRAIN IN TERMS OF CHANGES IN THEIR FUNCTIONS. G. Z. Abdullin (Inst. of Experimental Medicine, Academy of Medical Sciences, Leningrad). p.397-408 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In Russian)

It is now established that the functions of all parts of the brain are affected by radiation. However, the parts whose functions are most affected under these conditions is a question that was not thoroughly investigated. This problem was examined. The comparative-physiological method, which is accompanied by great technical difficulties, was employed. Pigeons and rabbits were selected as subjects in view of the dissimilarity in the development of the higher sections of their central nervous systems and difference in the degree of corticalization of functions. Brain functions were studied in detail by various methods: locomotory- and vegetative-conditioned reflexes, and electrophysiological research. The heads of the subjects were exposed to filtered x rays and other parts of the body were screened. Results obtained showed that ionizing radiations operate selectively on different nerve formations. In experiments with pigeons it was established that the functions which change more easily and quickly under the effect of radiation are chiefly those activated by the mesencephalic formations. This was deduced from the fact that the locomotory-conditioned reflexes which are mainly activated in these animals by the corpora striata and which disappear after decerebration (Bayandurov, Popov, Karamyan), were extremely radioresistant, while the locomotory-co-ordinated functions (pecking, flying) showed marked disturbance. This latter phenomenon was due to the functional disturbance of the nerve formations located below the hemispheres. It should be noted that vegetative (cardiac and respiratory) conditioned reflexes, in which nerve formations also located below the hemispheres are mainly concerned, showed greater changes, even when subjected to smaller radiation doses, than the locomotory-conditioned ones. The cerebral cortex in rabbits is a well-formed structure and, owing to the greater corticalization of the vegetative functions, ensures the higher regulation of those functions. The cardiac and particularly the respiratory-conditioned reflexes, which in rabbits are activated by the cerebral cortex, proved to be extremely radio-resistant, while the rhythm of cardiac activity and respiratory movements, reflecting the activity of the corresponding centers in the myelencephalon, showed considerable changes when exposed to comparatively small irradiation doses. A study of bioelectric activity in the brain (with parallel recording of biopotentials from the hemisphere surface (pigeons) or cortex (rabbits) and the hypothalamic area) showed that radiation causes considerable changes in all sections of the brain observed. The fact that biopotentials change under irradiation doses which do not cause substantial changes in the conditioned reflexes, activated chiefly by the prosencephalon in pigeons and by the cortex in rabbits, is evidence that these sections of the brain retain their regulatory functions even when their functional state undergoes certain x-ray-induced changes. The probable explanation of this lies in the compensatory and plastic properties of these sections. The relative radiosensitivity of the subcortico stem formations may be explained by the fact that a considerable part is played in their activity by humoral-chemical processes. (auth)

16282 EVIDENCE OF CENTRAL NERVOUS SYSTEM INVOLVEMENT IN RADIATION DAMAGE. W. O. Caster and W. D. Armstrong (Univ. of Minnesota, Minneapolis). p.411-24 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

After 700 r total-body x irradiation there are statistically significant alterations in both electrocorticogram and tissue chemistry (with respect to DNA, water, and electrolytes) in the central nervous system of the rat. The direction of the electrocorticographic changes and the times at which they occur are in good agreement with the three phases of alteration in conditioned reflex response as defined by Minaev. Three additional effects were observed which are most easily explained by assuming involvement of a central nervous system mechanism. The pattern of tissue-weight changes seen after total body irradiation could be reproduced by directing higher doses of radiation to the head, with the rest of the body being shielded. When 2000 r of x rays were directed to the head alone, there were major losses in weight of testes, spleen, small intestine, and other "radiosensitive" tissues. The changes in DNA concentration in the various tissues of the body were well synchronized, suggesting the involvement of some central control mechanism such as that described by Barnum, Jardetzky, and Halberg. The cardiac arrhythmia which was observed just prior to the LD_{50} death period was characterized by alterations in electrical events of the heart which were synchronized with the respiratory cycle, possibly due to alterations in vagal tone. (auth)

16283 COMPARISON BETWEEN THE RESPONSE VARIABILITY AND THE DEGREE OF THE HIGHER ACTIVITY OF THE NERVOUS SYSTEM. C. Biagini and M. di Paola (Università, Rome and Comitato Nazionale per le Ricerche Nucleari, Rome). p.425-47 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

Mammals exposed to a uniform radiation dose generally show different degrees of response, as is demonstrated by lethality values and by pathological findings in various tissues and organs. The variability of radiation response was related to the degree of activity of the nervous system. The following experimental psychological methods were employed in mice and rats: evaluation of emotional behavior; measurements of volitional activity (actophotometry); adaptation to social life; tendency to liberation; learning-response with motor-defensive techniques; and lever-pressing response. Special care was given to the evaluation of the factors affecting the results of the applied methods. In some groups of animals the degree of correlation between the results of the different methods was determined. Mice and rats were classified on the basis of the degree of activity of the nervous system, and in some experiments extreme classes were chosen to compare the effects of radiation. Total-body irradiations were performed with 150 to 250 kvp x rays, or Co^{60} gamma rays; the doses ranged from 500 to 850 r. Some experiments were performed with 50-r doses of x rays. Among the effects of radiation, lethality, body-weight loss, reduction of weight in some organs, and histological findings were considered. The results of the investigation, obtained during the last two years, showed that a single irradiation, with doses from 500 to 850 r, appears more effective on the mice, characterized by poor adaptation to social life, higher values of actophotometry scores, and higher rates of emotionality. The consequences of single, or repeated irradiations with doses of 500 to 850 r, were more severe on the rats with poor rates of learning-response. Radiation effects on lymphatic tissue also appeared more serious in the rats characterized by poor learning-response, after being irradiated with 50 r of x rays. The influence of various factors affecting the experimental results is discussed. The data were submitted to statistical analysis; the results appear consistent with the interpretation of a higher radiation response in the subjects with a nervous system of a weak or unbalanced type. (auth)

16284 ROLE OF THE NERVOUS SYSTEM IN THE CHANGES OF "METABOLIC REACTIVITY" OF THE IRRADIATED ORGANISM. L. Novák, A. Vacek, and M. Pospíšil (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). p.450-9 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In Russian)

The original method for continuous observation of changes in the reactivity of the intact organism, based on continuous measurement of gas exchange in experimental animals, was elaborated. The application of this method in biological experiments is based on the idea that gas exchange intensity under various conditions of adaptation represents the integral form expressing the metabolic activity of the organism. This metabolic activity of the organism represents the measure of reactivity. The nervous system activity included in this integral metabolic process is of great importance in the maintenance of dynamic equilibrium between the organism and the external environment. The results are presented which were obtained by this method in experimental animals (rats, rabbits, chickens) immediately after repeated irradiation at hourly or daily intervals. Observations of the functional significance of the central nervous system resulted in the following: metabolic reactivity in experimental animals depends on the functional integrity of the nervous system; and the reactive (adaptive) component of metabolism may be very easily observed by the method used in our experiments and facilitates observation of the changes developing in the irradiated organism. The possible use of the method described for differentiation of individual radiosensitivity in irradiated animals is the point of discussion. (auth)

16285 RADIATION RESPONSE OF WHITE MICE TO X-IRRADIATION OF SMALL SEGMENTS OF THE SPINAL CORD WITHIN A DOSE-RANGE UP TO 4 Mr. K. Heuss and H. Hobitz (Max Planck-Institut für Biophysik, Frankfurt am Main). p.461-9 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

In male white mice, 3 months of age, small fields (7 × 9 mm) were x-irradiated in posterior-anterior position at the following locations: 5th lumbar vertebra; 1st lumbar vertebra; and 7th cervical vertebra. The doses ranged up to 4 Mr. Irradiation was done under the following conditions: 65 kvp, 1000 ma, HVL 0.9 mm Al, dose-rate 40 to 400 kr/min, and FD 7 cm. Irradiation at the area of the 5th lumbar vertebra resulted in early deaths at a dose of about 10 kr. In the dose-range between 15 and 40 kr the mean survival time (MST) remained unchanged and was about 4 days. Decreasing with higher doses, MST reached the value of 3 hr, corresponding to a dose of 2 Mr. Most of the animals exhibited a stuporous state; sometimes paralysis of the lower limbs was seen. Irradiation at the area of the 1st lumbar vertebra resulted in a course similar to that seen after irradiation of the 5th lumbar vertebra. However, the plateau was found to be between 40 and 80 kr and was less evident. The main symptom of this irradiation position was paralysis of the lower limbs, the onset of which showed close relationship to the amount of the dose applied. Paralysis was already evident during the course of irradiation, starting at doses of 200 kr. Irradiation at the area of the 7th cervical vertebra displayed quite a different picture; for instance, splitting up of the MST at doses of about 30 kr and more. Sudden deaths occurred at doses of about 300 kr. A comparison of these results with those gained from former investigations on the effects of whole-body x irradiation lead to the conclusion that, with increasing dose, the nervous system becomes the critical organ in mammals. (auth)

16286 THE SENSITIVITY OF THE NERVOUS SYSTEM TO LOW-LEVEL RADIATION. M. N. Livanov (Inst. of Higher Nervous Activity and Neurophysiology, Moscow). p.471-82 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In Russian)

Early effects of irradiation on the central nervous system can be observed by registering biopotentials simultaneously with irradiation. Study of the dependence of such effects on dose-rate and irradiation time revealed a high degree of sensitivity of the nervous system to penetrating radiations. Comparison of the "strength-duration" curves derived for the cases of total radiation, and irradiation of the head, stomach, and haunch of rabbits, led to the inference that summation of the effects of irradiating various afferent zones takes place. Great differences are shown to exist in the individual radiosensitivity of animals. Some animals reveal almost entirely negative initial reactions, or react late to the effect of small radiation doses. Others respond swiftly to doses of the level of tenths or hundredths of roentgens. No direct relationship exists between radiosensitivity and the speed with which pathological processes develop. Thus, after an LD_{50} dose, rabbits die in cases where their nervous system is of low radiosensitivity. Animals with early and marked initial reactions, on the other hand, survive such irradiation. It was found that, for minimal doses of ionizing radiation producing reactions in the biopotentials of the cerebral cortex, defensive conditioned reflexes can be produced. Irradiation in this case plays the part of the conditioning signal, and electro-skin stimulation of the extremities is a reinforcing factor. Changes induced by small doses of ionizing radiation display a cumulative tendency. (auth)

16287 ON THE ACTION MECHANISM OF IONIZING RADIATION TO IRRITATION PROCESSES. H. D. Bergeder (Universität, Bonn). p.485-8 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

The process of irritation is preceded by sudden, reversible changes of the permeability of the membranes, where the following short-term displacement of ions and charges takes place at the membranes. If there is a change of irritability during or after the influence of ionizing radiation, it may refer to a change of the properties of the membranes induced by the radiation. There are several indications, but at present no direct proof of a primary effect of ionizing radiation on biological membranes. There are, however, certain conditions of these membranes which should be considered with the question of the profound influence of radiation on the irritation and irritability, phenomena which are in close relation with processes at the membranes. The potential of the membrane is formed by the electrical double-layer on the membrane. Therefore, the membrane is located within an electrical field of an order of 10^5 V cm^{-1}. Contrary to any other localization within the cell, the ion pairs formed during absorption of ionizing radiation here are exposed to a strong electrical field. (auth)

16288 HYPOTHESES ON THE ACTION MECHANISMS OF THE EFFECT OF IONIZING RADIATION ON THE NERVOUS SYSTEM. O. Hug (Strahlenbiologisches Institut, Munich). p.489-98 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962. (In English)

The hypotheses related to the results showing an instantaneous and reversible radiation effect in some types of excitable tissues is reviewed. The transient change of the permeability of the cell membrane, the effect of pharmacoactive substances liberated or activated by irradiation, and the role of the differences in the functional status were taken into account for the explanation of possible action mechanisms. (auth)

Radiation Sickness

16289 PROTECTION OF LETHALLY X-IRRADIATED MICE WITH CELLS OF WHOLE EMBRYO: A QUANTITATIVE STUDY. Norman S. Wolf and Edwin T. Nishimura (Northwestern Univ., Chicago). Lab. Invest., 11: 136-49(Feb. 1962).

Adult strain A mice were given 790 r of whole-body x irradiation measured in air. After irradiation, isologous or homologous whole embryo cells were injected intravenously in doses of 2×10^6, 7×10^6, or 25×10^6 viable cells. Embryos of mixed ages were used for the isologous cell injections. The embryos used for homologous cell injections were divided into three postconception age groups: 11 to 12 days, 14 to 15 days, and 18 to 19 days. Thirty-day survival rates for mice treated with isologous embryo cells were about 30, 50, and 75% for the three ascending cell dosages. The survival rates among mice receiving 14- to 15-day or 18- to 19-day homologous embryo cells at the 2×10^6 and 7×10^6 viable cell dosages were close to those of mice receiving the same isologous doses. However, the 25×10^6 homologous cell dose resulted in no increase in survival rate over the 7×10^6 cell dose. The 30-day survival rate for mice given injections of 11- to 12-day embryo was nearly zero. The comparison of the incidence of late deaths between the isologous and the homologous cell-treated mice gave no evidence that homologous disease was occurring in the latter group. Skin transplants performed 2 months after the time of irradiation and cell injection suggested persistence of hematopoietic tissue originating from the 18- to 19-day homologous embryo. Age (between 3 and 13 months) and weight of the mice receiving x irradiation followed by whole embryo cell injections were not found to be important variables affecting the 30-day survival rate, but male mice were found to have a significantly higher survival rate than females. (auth)

16290 ISOSEROLOGICAL PROPERTIES OF THE BLOOD DURING RADIUM THERAPY. R. M. Urinson and M. P. Bogoyavlenskaya (Central Inst. of Hematology and Blood Transfusion, Ministry of Public Health, USSR). Med. Radiol., 7: No. 3, 20-3(Mar. 1962). (In Russian)

In patients with chronic radiation sickness developing as the result of radium therapy for malignant tumor, the serological properties of the blood were, with a rare exception, stable and did not differ from those of the blood of healthy persons. Only some shifts were noted in a number of patients towards rise of the titer of heteroagglutinins in respect to erythrocytes of sheep. (auth)

16291 INTRAOSSEOUS INTRODUCTION OF HOMOLOGOUS BONE MARROW TO LETHALLY IRRADIATED RATS. K. A. Lebedev (Inst. of Epidemiology and Microbiology, Academy of Medical Sciences, USSR). Med. Radiol., 7: No. 3, 24-8(Mar. 1962). (In Russian)

Approximately 50% of rats irradiated with a minimum lethal dose of roentgen and gamma rays may be cured from radiation sickness if they undergo intraosseous transplantation of homologous bone marrow. The efficacy of the intraosseous method of administration is almost similar to the effectiveness of the intravenous method of bone marrow introduction. The curative effect of homotransplantation in rats is observed with irradiation doses not exceeding the absolute lethal dose more than 100 r. In the intraosseous method of introduction the operative trauma causes an activation of the endosteum and flares up the endosteal osteogenesis. This does not prevent the take and differentiation of the hematopoietic tissue in the medullary cavity at the site of introduction. The hematopoietic cells introduced intraosseously become distributed, apparently, in the same manner as in their intravenous administration. (auth)

16292 THE MECHANISM OF ENDOGENIC FORMATION OF CARBON MONOXIDE IN ACUTE RADIATION SICKNESS. V. V. Kustov. Med. Radiol., 7: No. 3, 28-31 (Mar. 1962). (In Russian)

The influence of complex triethylenetetraamine compounds, which are endowed with a catalase-like action for the accumulation of carbon monoxide, in the *in vitro* irradiated blood and in rabbits affected with radiation sickness was studied. The compounds protect hemoglobin from oxidation with hydrogen peroxide and organic peroxides and, thus, diminish the endogenic formation of carbon monoxide in acute radiation sickness. (auth)

16293 THE EXCRETION OF DESOXYCYTIDINE WITH THE URINE IN ACUTE RADIATION SICKNESS. K. S. Kosyakov, N. I. Libikova, and T. N. Merkina. Med. Radiol., 7: No. 3, 31-5(Mar. 1962). (In Russian)

In experiments staged on irradiated rats (400, 700, and 800 r), a distinct rise of desoxycytidine excretion with the urine was revealed during the first day in all the animals. On the 3rd day this increase was changed by a normal content of the substance in the urine. Upon protection of the animals with cystamine in the majority of them there was no augmented discharge of desoxycytidine. The irradiation of dogs in a dose of 500 r was attended in the majority of cases by an elevated content of Diche-positive substances in the urine collected within the first 24 hours. The intensity of cysteine reaction in the urine of healthy persons and patients affected with different internal diseases ranges widely. In single irradiation of oncological patients (therapeutic x-ray dose) no augmented discharge of desoxycytidine with the urine could be revealed. (auth)

16294 NITROGEN METABOLISM IN DOGS WITH ACUTE RADIATION SICKNESS AGAINST THE BACKGOUND OF MILK-EGG DIET. A. S. Kainova. Med. Radiol., 7: No. 3, 35-9(Mar. 1962). (In Russian)

Dogs receiving a diet, consisting of milk and eggs, were subjected to twofold roentgen irradiation (doses of 400 r each). After the irradiation the animals retained a positive nitrogen balance. Changes in the nitrogen metabolism occurring under the influence of irradiation in dogs, receiving the above-mentioned diet, were relatively inconsiderable. A supposition that the referred to diet is endowed with a certain protective effect in radiation injury is set forth. (auth)

16295 LATENT INFECTIONS IN MONKEYS WITH RADIATION SICKNESS INDUCED BY FRACTIONAL IRRADIATION. E. K. Dzhikidze and A. S. Aksenova (Inst. of Experimental Pathology and Therapy, Academy of Medical Sciences, USSR). Med. Radiol., 7: No. 3, 53-8(Mar. 1962). (In Russian)

Work was carried out on 29 monkeys, most of them carriers of dysentery bacteria, subjected to multifold action of roentgen (12 monkeys) and gamma rays (17 monkeys) in daily doses of 16–26 and 34 r. A very early appearance of symptoms of radiation sickness was observed, which by clinical and morphological manifestations resembled an acute radiation process. 26 out of 29 monkeys died in periods of 27 to 95 days from the start of the experiments, the total doses ranging from 450 to 1699 r. At different periods after the irradiation 25 monkeys developed infectious complications, in the majority of cases associated with activation of latent dysenteric infection (18 monkeys). The course of infectious processes against the background of radiation sickness was frequently of an atypical nature with scarce manifestations of the main symptoms of the disease. (auth)

16296 THE RADIOPROTECTIVE EFFECT IN COMBINED USE OF PREPARATIONS. P. G. Zherebchenko, I. G. Krasnykh, E. I. Kuznets, N. N. Suvorov, V. S. Shashkov, and S. P. Yarmonenko. Med. Radiol., 7: No. 3, 67-71 (Mar. 1962). (In Russian)

The potentiation of the radioprotective effect in combined use of tryptamine with mercamine (propamine) or histamine and mercamine with histamine is demonstrated. Intensification of the protective effect in combined utilization of preparations is considered as a confirmation of the differences in the mechanism of their action. In the combined use of tryptamine and AET the toxic action became augmented, while there was no intensified protective effect, this being due to the inhibiting influence of AET on the process of oxidative deamination of tryptamine. (auth)

16297 PROTECTION AGAINST THE TOXIC EFFECTS OF X-RAY AND NITROGEN MUSTARD ON E. COLI 0111 BY RADIOPROTECTORS. F. Hernádi, T. Vályi-Nagy, Zs. Nagy, and A. Jeney (Debrecen Medical Univ., Hungary). Radiation Research, 16: 464-70(Apr. 1962).

The protective activity of sixteen radioprotectors against x ray and HN_2 lethality was compared by a microbiologic method. Test organism E. coli 0111 (E. coli B_4) was used. On comparing the effect of compounds in an equimolar quantity, SH—substances and serotonin were found to be most reactive to both toxic agents. The greatest difference was shown by MAD, which displayed protective activity against x radiation but did not influence the effect of HN_2. (auth)

16298 STUDIES ON CHEMICAL PROTECTION AGAINST RADIATION IN JAPAN. Masasi Fukuda (Kyoto Univ.). Strahlentherapie, 117: 142-6(Jan. 1962). (In English)

An outline is presented of the research on the chemical protection against radiation done in Japan. The effect of many kinds of radiation—protective chemicals was confirmed with the use of various biological indicators. But there is still more room to study the mechanism of these protective substances. In this regard, the relationship between the protective reaction and free radicals must be examined. And there are many aspects to be studied in future with regard to the application of chemical protection to the human body, which is the destination of this research. (auth)

16299 STUDY ON A BIOLOGICAL RADIATION PROTECTION. XLV. ACTION OF RADIATION PROTECTION SUBSTANCES ON THE RADIATION DAMAGE OF BONE MARROW, SPLEEN, AND THYMUS. Hanns Langendorff and Ulrich Hagen (Universität, Freiburg i. B. and Heiligenberg-Instituts, Ger.). Strahlentherapie, 117: 321-9 (Mar. 1962). (In German)

The reaction of thymus, spleen, and bone marrow of mice, treated with the radiation protective substances 5-hydroxytryptamine (serotonin) or cysteamine before an x-ray irradiation is investigated and compared with untreated, irradiated animals. The radiation injury in spleen and thymus is, in both groups, the same during the first few days. Later, only the protected animals show a faster recovery of the organs. A protection effect in the bone marrow can be seen to occur immediately after irradiation. The decrease of the cell counts in the marrow is less significant in the treated animals; the protection factor is about 2. It is probable, that only a few cells in the bone marrow are protected against the radiation injury by the protection substances. However, the direct proof of the existence of those cells still has to be established. (auth)

16300 EXPERIMENTS ON THE MECHANISM OF RADIATION PROTECTIVE ACTION OF OXYTRYPTAMINE DERIVATIVES. Peter Dukor (Dermatologische Universitätsklinik, Basel). Strahlentherapie, 117: 330-55(Mar. 1962). (In German)

The radiation protection effectiveness of several substituted derivatives of oxytryptamine was investigated using the survival time of total-body irradiated white mice. 5-methoxytryptamine and 5-hydroxy-ω-N-monomethyltryptamine have the same protective effect as serotonin, 4-hydroxytryptamine is not very effective, while all other substituted compounds investigated are nearly ineffective. The radiation protection effectiveness of the oxytryptamines does not quite conform to their other pharmacologic effects. However, it depends upon a specific molecular structure. The protective effect of serotonin derivatives is erased almost completely by deseril. The duration of the protective effect can be prolonged significantly by methylating of the 5-hydroxy group of serotonin or by inhibition of the monoaminoxydase. Like reserpine, tetrabenazine, a serotonin-liberator, has a protective effect, which is insufficient for common purposes. Several hydrazines and thiaethylperazine are ineffective. The death rate of the animals, used for the experiments showed a distinct decrease using Reverin for antibiotical protection. A high radiation protective effect was obtained with 5-hydroxytryptamine, 5-methoxytryptamine, 4-hydroxytryptamine, and substance 48/80, using the Brinkman-Lamberts apparatus for measurements of the injection pressure, with which oxygen-independent radiation effect can be determined. The discussion explains, that neither the indirect physiological effects (e.g. vasoconstriction) of the oxytryptamines nor a neutralization of free radicals of water are important for their effectiveness. Rather, the existence of a reversible compound, radiationsensitive substrate/oxytryptamine, must be assumed. (auth)

16301 CONTRIBUTION TO THE PATHOGENESIS OF LATE RADIATION INJURY. Julius Kiss (Univ. of Pécs, Hungary). Strahlentherapie, 117: 474-8(Mar. 1962). (In German)

Several examinations of the electrolytic permeability of the skin of patients, who were irradiated with 4000 to 6000 r of short source-skin distance x rays, show a considerable decrease. An electropermeograph, which was modified by the author, was used. By these changes of the electrolytic permeability, which can be determined for several years, the tissue nourishment in the irradiated skin area, probably, deteriorates too. Because of this, a late x-ray-injury could develop. (auth)

CHEMISTRY

General and Miscellaneous

16302 (ASC-TR-61-234) HANDBOOK OF DESIGN DATA ON ELASTOMERIC MATERIALS USED IN AEROSPACE SYSTEMS. Technical Report, February 5, 1960 through June 30, 1961. A. G. Pickett and M. M. Lemcoe (Southwest Research Inst., San Antonio). June 1961. Contract AF33(616)-7093. 237p.

The objective of this handbook is to provide aerospace weapons system design engineers with useful data on the materials properties of elastomers. The sources of this information are Department of Defense research reports and the technical literature of engineering design and elastomer technology. The elastomeric materials for which data are presented are compounds of high polymers currently available in the U. S. A. The properties considered are original mechanical and physical properties and the changes in these properties that result from aging and exposure to environments of aerospace weapons systems. A selected bibliography of technical literature on elastomers and elastomeric parts is included. (auth)

16303 HIGH TEMPERATURE RADIATION RESISTANT SILICONE RUBBER. John C. Saylor (to Dow Corning Corp.). U. S. Patent 3,032,531. May 1, 1962.

A siloxane copolymer giving cured stocks with good radiation resistance even at temperatures above 200°C, consists of 3 to 35 mole % diphenylsiloxane units and 65 to 97 mole % phenylmethylsiloxane units. Vinylsiloxane units can be used in amounts less than 1 mole % as endblocking units. The copolymers can be prepared by heating together the tetramers or trimers of the siloxanes in the presence of a catalyst, preferably an alkali metal silanolate or siloxanolate. (D.L.C.)

Analytical Procedures

Refer also to abstracts 16089, 16686, 16687, 16688, and 16690.

16304 (CNEN-96) DETERMINAZIONE SPETTROGRAFICA DI BORO, ALLUMINIO, FERRO, CROMO, MANGANESE IN COMPOSTI DI URANIO. (Spectrographic Determination of Boron, Aluminum, Iron, Chromium, and Manganese in Uranium Compounds). R. de Leone, L. Lorenzini, and C. Stoppa (Italy. Comitato Nazionale per l'Energia Nucleare. Divisione Materiali, Rome). Oct. 1961. 33p.

Report Presented at the "IX Spectrochemical Seminar" of the Italian Metallurgy Association, held at Abano Terme on May 13-16, 1961.

The analysis of the uranium metal impurities is made with the carrier distillation method. The samples to be analyzed, converted to the refractory oxide U_3O_8, are excited in a continuous current arc after mixing with a suitable carrier. Ga_2O_3 and NaF were tested as carriers and the volatilization curves of some elements were obtained. The standards for B, Al, Fe, Mn, and Cr were prepared and subsequently the working curves were drawn by the external standard method. A comparison was made for Fe using as carrier Ga_2O_3 and NaF and the working curves were drawn using both internal and external standard methods. The results obtained demonstrate the feasibility of quantitative determinations of the above elements by the external standard method; standard deviations are lower than 10%. (auth)

16305 (EURAEC-163) NUCLEAR APPLICATION OF TRANSIENT ELECTROANALYTICAL METHODS. Quarterly Report No. 4, April 1—June 30, 1961. (Brussels. Université). Work performed under United States—Euratom Joint Research and Development Program. Contract [018-60-7RDB]. 6p.

The following work was carried out: implementation, perfecting, and bringing into operation the potentiostatic polarization unit; its integration into the equipment as a whole; the comparative examination of various measurement electrodes; and the experimental investigation of the prepolarization voltage on the galvanostatic method, with reference to its incidence on the uranyl ion dosimetry. (auth)

16306 (PAN-250/XIII) EIN BEITRAG ÜBER DIE ANWENDUNG DER "COPPER SPARK"-METHODE IN DER ANALYSE RADIOAKTIVER LOSUNGEN. (A Contribution to the Use of the Copper Spark Method in Analysis of Radioactive Solutions). J. Fijałkowski and A. Zelle (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 10p.

The spectrographic "copper spark" method has found especially great use in the trace analysis of radioactive solutions. The influence of various factors, such as the preparation of the electrodes, the preparation of the standard solution, and the method of application and evaporation of the solution are discussed. The detection sensitivity of the method was reduced by the presence of metals in the solution in amounts from 50 to 100 μg/ml and strong acidity. The method of the application and evaporation of the solution on the copper electrode influences the accuracy of the determination. (tr-auth)

16307 (PG-Report-293) ANALYTICAL METHOD FOR THE VOLUMETRIC DETERMINATION OF ALUMINIUM IN URANIUM METAL (UP TO 0.1% ALUMINIUM). (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1962. 7p.

The Al is separated from U by ion exchange. Metal ions in the eluate are complexed with EDTA. KF is used to liberate EDTA equivalent to the Al present. (J.R.D.)

16308 (PG-Report-296) ANALYTICAL METHOD FOR THE DETERMINATION OF BORON IN URANYL NITRATE SOLUTIONS. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1962. 9p.

A method was developed for the determination of boron in uranyl nitrate solutions. The boron is separated from uranium and other impurities by distillation of methyl borate. It is determined absorptiometrically by means of curcumin in the presence of orthochlorophenol, perchloric acid, and acetic anhydride. The limit of detection is judged to be not greater than 0.05 μg, but is dependent on the purity of the reagents used. The coefficient of variation on 210 results at the 0.2 μg boron level was 26% with a bias of −25%. The method may be applied to depleted uranyl nitrate solutions and uranium slag recovery liquors. (auth)

16309 (PG-Report-308) ANALYTICAL METHOD FOR THE DETERMINATION OF RUTHENIUM-103 AND RUTHENIUM-106 IN SAND, VEGETATION, SEAWEED, FISH FLESH AND NATURAL WATERS. (United Kingdom

Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1962. 16p.

A method is presented which is suitable for the determination of Ru^{103} and Ru^{106} in area survey samples of sand, vegetation, seaweed, and fish flesh, and also in natural waters. Detection limits are governed by natural background radiation which is dependent upon local conditions, but the method has been applied to samples containing 10 to 100 $\mu\mu$c of Ru^{103} and to samples containing 5 to 1000 $\mu\mu$c of Ru^{106}. Using the calibration procedure specified, it is considered that the bias is negligible. Interchange between added carrier and radio-ruthenium in the sample is effected either by fusion with potassium hydroxide in the case of solid samples or by boiling aqueous samples in alkaline solution, in the presence of an oxidant. Ruthenium is extracted as tetroxide into carbon tetrachloride and precipitated as the dioxide. After mounting on stainless-steel trays, the beta and gamma activities are measured. The counters are calibrated against sources of known Ru^{103} and Ru^{106} content. The observed activities are corrected for the chemical yield of the separation procedure, determined by absorptiometric measurement of a solution prepared from the source after counting. (auth)

16310 CONTROLLED POTENTIAL COULOMETRY IN FUSED LITHIUM CHLORIDE–POTASSIUM CHLORIDE EUTECTIC. John D. Van Norman (Brookhaven National Lab., Upton, N. Y.). Anal. Chem., 34: 594-6(May 1962). (BNL-5816)

Analyses for Zn(II) and Cd(II) in the fused lithium chloride–potassium chloride eutectic at 450°C were performed by controlled potential coulometric stripping of the predeposited metal from a bismuth pool electrode, and Ni(II) was determined by controlled potential stripping of the predeposited metal from a platinum gauze electrode. Analyses were performed with an accuracy and precision of ±1% in all cases. Mixtures of cadmium and zinc were analyzed with an accuracy of ±1% for each component by successive stripping of the metals at suitable potentials. This method was also applied to the determination of uranium in uranium–bismuth alloys. (auth)

16311 IRON-55 X-RAY ABSORPTION ANALYSIS OF ORGANICALLY BOUND CHLORINE USING CONVENTIONAL PROPORTIONAL COUNTING FACILITIES. L. H. Griffin (Shell Chemical Co., Deer Park, Tex.). Anal. Chem. 34: 606-9(May 1962).

Modified iron-55 x-ray absorption techniques incorporating conventional proportional counting facilities permit nondestructive analysis of chlorine in a variety of organic materials with good precision and speed. Variations in the technique permit analyses over a wide concentration range. Application of the method as described is limited to technical grade and finished products. (auth)

16312 DETERMINATION OF NIOBIUM AND TANTALUM IN MINERALS, ORES, AND CONCENTRATES USING ION EXCHANGE. Silve Kallmann, Hans Oberthin, and Robert Liu (Ledoux and Co., Teaneck, N. J.). Anal. Chem., 34: 609-13(May 1962).

The hydrochloric–hydrofluoric acid system was found suitable for the determination of niobium and tantalum in various minerals and ores by ion exchange procedures. No preliminary separations are required, and the ion exchange steps provide cleancut separations from virtually all elements with which niobium and tantalum are associated. Tin, antimony, and bismuth require minor modifications of the procedure. The decomposition of the sample depends to some degree on its composition; a hydrochloric–hydrofluoric acid attack under light pressure is suitable in most instances. (auth)

16313 SPECTROPHOTOMETRIC DETERMINATION OF TANTALUM IN IRON, STEEL, AND NIOBIUM METAL. Yachiyo Kakita and Hidehiro Gotô (Tohoku Univ., Sendai). Anal. Chem., 34: 618-21(May 1962).

A procedure for the determination of small amounts of tantalum in iron, steel, and niobium metal is described. Tantalum forms a complex salt with malachite green in the presence of hydrofluoric acid, and this salt is extracted with benzene or xylene. Usually boron is the only element present in the sample which undergoes a color reaction similar to that of tantalum, and it can be removed easily by fuming with sulfuric acid to volatilize it as boron trifluoride. After dissolution of the sample with sulfuric acid, the solution is diluted with ammonium oxalate solution. Hydrofluoric acid is added to a part of this solution, the sulfuric acid concentration is adjusted to about 0.1N with sodium hydroxide, and malachite green is added. The complex salt is extracted with benzene, and tantalum is determined by measurement of the absorbance of the benzene layer at 635 mμ. From 0.005 to 0.5% of tantalum can be determined with good accuracy without any preliminary separation of tantalum. This method should also be applicable to a somewhat wider range (from 0.001 to 5%) of tantalum. (auth)

16314 DETERMINATION OF TIN AND MOLYBDENUM IN NUCLEAR REACTOR AND OTHER MATERIALS. EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION WITH 8-QUINOLINOL. A. R. Eberle and M. W. Lerner (New Brunswick Lab., N. J.). Anal. Chem., 34: 627-32(May 1962).

To eliminate the tedious and erratic distillation separation of tin, a new 8-quinolinol extraction–spectrophotometric procedure was developed. Both tin and molybdenum are determined in uranium, beryllium, thorium, zirconium, steels, and other materials. The method involves the extraction of molybdenum from a sulfate solution in the absence of halide, followed by the addition of halide and the extraction of tin. The molybdenum procedure can be made specific; tungsten interference in the tin procedure can be readily eliminated. The procedure is rapid, accurate, and precise. (auth)

16315 SPECTROPHOTOMETRIC DETERMINATION OF NIOBIUM AS REDUCED MOLYBDONIOBIC ACID. J. C. Guyon and G. W. Wallace, Jr., and M. G. Mellon (Purdue Univ., Lafayette, Ind.). Anal. Chem., 34: 640-3 (May 1962).

The reduction product of a complex molybdoniobate is used as the basis for a spectrophotometric method for the determination of niobium(V). The effects of several variables on the color-forming reactions are described, along with the optimum conditions for formation of the blue hue. The system conforms to Beer's law in the range 0.1 to 10 ppm for a 1-cm cell. The system was applied to the determination of niobium in steel. (auth)

16316 DETERMINATION OF RADIOACTIVE CALCIUM BY LIQUID SCINTILLATION COUNTING. Marlene Sarnat and Henry Jeffay (Univ. of Illinois, Coll. of Medicine, Chicago). Anal. Chem., 34: 643-6(May 1962).

A liquid scintillation method for measuring calcium-45 is described. The method consists of precipitating calcium as the oxalate salt, converting this salt to the nitrate, and counting the nitrate in a solvent system of toluene–ethyl alcohol–ethylene glycol–nitric acid containing an organic scintillator. (auth)

16317 INTERNAL STANDARD TECHNIQUE FOR PRECISE ISOTOPIC ABUNDANCE MEASUREMENTS IN THERMAL IONIZATION MASS SPECTROMETRY. L. A. Dietz, C. F. Pachucki, and G. A. Land (General Electric Co., Schenectady, N. Y.). Anal. Chem., 34: 709-10(May 1962).

An internal standard technique which gives more than a 5-fold improvement in the precision of an isotopic analysis made in a thermal ionization mass spectrometer is described. The technique developed has application in the following fields: certain half life determinations; geochemical age determinations; nuclear absorption cross sections and low isotopic burnup; and isotopic dilution analysis for the assay of uranium. To apply the technique, three or more isotopes of an element must be present so that two different isotopic ratios of the same element can be compared in such a manner as to eliminate almost completely mass discrimination (instrument bias). The flexibility of the internal standard technique to problems which are amenable to surface ionization mass spectrometry is clarified in discussions given on its application to uranium isotope abundance measurements and to a new determination of the half life of Cs^{137}. (P.C.H.)

16318 ANALYTICAL APPLICATIONS OF THE MERCURY ELECTRODE. A REVIEW. J. A. Page (Univ. of Toronto), J. A. Maxwell, and R. P. Graham. Analyst, 87: 245-72(Apr. 1962).

A review is given on electrolysis in which there is a quantitative reaction of analytical interest at a mercury electrode or, at the very least, an appreciable amount of reaction at such an electrode. Reference is also made to polarography when it is used in conjunction with some procedure that falls within scope. Discussion is given on reductions with and without and oxidations with external control of electrode potential, coulometric determinations at controlled current, and amalgamometry. Separate tables are given for the separation and electrolysis of various ions. 423 references are included. (P.C.H.)

16319 THE USE OF DITHIZONE–CELLULOSE ACETATE COLUMNS OF INCREASED CAPACITY IN THE DETERMINATION OF INDIUM BY PIERCE AND PECK'S NEUTRON-ACTIVATION METHOD. D. Mapper and J. R. Fryer (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Analyst, 87: 297(Apr. 1962).

In a reverse phase partition chromatographic method for the rapid chemical separation of indium, it was found that columns of greater capacity can be prepared if the dithizone–cellulose acetate powder is completely dried initially in a current of air and then treated with a further volume of saturated dithizone solution when required for use. The greater capacity columns have several advantages over those used previously: the method of preparation permits the dried dithizone–cellulose acetate powder to be stored ready for use when required, the faster rates of flow permit separations to be carried out even more rapidly, and a column can be used as many as ten times before it needs to be replaced. The technique is used for samples of iron meteorites containing from 0.001 to 0.04 ppm of indium and a known gallium content from 10 to 95 ppm. (P.C.H.)

16320 DETERMINATION OF RHODAMINE B IN NATURAL WATER. M. Marichal and R. Benoit (Commissariat à l'Énergie Atomique, France). Chim. anal., 44: No. 2, 70-2(Feb. 1962). (In French)

Rhodamine B is extracted from a water sample with isoamyl alcohol, and the alcohol solution is clarified. The Rhodamine B is determined by spectrophotometric analysis of the clarified alcohol solution. The method has a sensitivity of 10^{12} at a Rhodamine B concentration of 10^{-9} g/liter. (T.F.H.)

16321 DETECTION OF BERYLLIUM BY A (γ,n) REACTION. Patrice Dumesnil (Centre d'Études Nucléaires, Saclay, France). Inds. atomiques, 5: No. 11-12, 61-6(1961). (In French)

Beryllium is detected by the reaction $Be^9(\gamma,n)Be^8$. The gamma photons are furnished by an antimony-124 source; the neutrons are detected by BF_3 counters. An apparatus designed for the detection of minerals containing beryllium was constructed. It contains a 50 to 100-mc source and four counters. Its sensitivity is 11 discharges/min/mc for a 1% concentration in BeO. The experimental apparatus for the detection of Be in aerosols has a 2-c source and ten counters. The sensitivity obtained is 0.24 discharges/min/c for a μg of beryllium. (tr-auth)

16322 SEPARATION AND DETERMINATION OF ZIRCONIUM USING DIAMMONIUM-5,5'-INDIGO DISULPHONATE. B. D. Jain and J. J. Singh (Univ. of Delhi). J. Less-Common Metals, 4: 145-8(Apr. 1962). (In English)

Diammonium-5,5'-indigo disulfonate precipitates zirconium quantitatively between pH 1.0 and 4.0. The precipitate on ignition gives ZrO_2, which can be weighed. Zirconium can be readily estimated in the presence of iron, titanium, aluminum, beryllium, uranium, cerium(III), nickel, and cobalt. (auth)

16323 DETERMINATION OF $MsTh_1$ BY $MsTh_2$ β PARTICLES IN PRESENCE OF Rd-226. P. I. Chaikin, N. V. Golubev and V. G. Zherekhov. Radiokhimiya, 4: 102-7 (1961). (In Russian)

The separation and determination of $MsTh_1(Ra^{228})$ with barium sulfate in porous crucibles are described, and a correcting system for determining MsTh, in presence of Rd^{228} is given. The β particle method of $MsTh_1$ determination is much more efficient than the radiothorium increase method and can be used for determining MsTh quantities 10^{-5} g/g in specimens weighing 15 g. (R.V.J.)

16324 DETERMINATION OF RADIOACTIVE CESIUM BY FERROCYANIDE. A. Ya. Gel'fman and L. Z. Kalmykov. Radiokhimiya, 4: 107-10(1961). (In Russian)

Determination of Cs^{137} by precipitation as mixed ferrocyanide is described. The order of error is 6%. The method is used for determining Cs^{137} in food stuff, urine, and water. (R.V.J.)

16325 DETERMINATION OF LOW LEVEL RADIOACTIVITY IN CONTAMINATED WATER. V. P. Shvedov, E. P. Ankudinov, B. G. Bunin, A. M. Maksimova, and L. M. Ivanova. Radiokhimiya, 4: 110-16(1961). (In Russian)

Methods for sampling, concentrating, and assaying radioactive water are discussed. (R.V.J.)

16326 THE DETERMINATION OF TRACES OF RUTHENIUM IN SAMPLES OF PLATINUM BY NEUTRON-ACTIVATION ANALYSIS. R. A. Killick and D. F. C. Morris (Brunel Coll. of Tech., London). Talanta, 9: 349-53(Apr. 1962). (In English)

The procedure depends on the chemical separation of radioactive ruthenium, with added ruthenium carrier, from irradiated samples and standards. Results are quoted for the ruthenium contents of a number of samples of platinum. (auth)

16327 IMPROVED PYROGALLOL DETERMINATION OF NIOBIUM BASED UPON EXTRACTION OF A QUATERNARY AMMONIUM ION COMPLEX. José A. Catoggio and L. B. Rogers (Massachusetts Inst. of Tech., Cambridge). Talanta, 9: 377-86(Apr. 1962). (In English)

The optical absorbance produced by mixing Nb^{5+} with pyrogallol in a slightly alkaline solution is increased approximately 60% by the presence of a long-chain quaternary ammonium compound. In addition, the interferences from Mo^{6+}, W^{6+}, and Cr^{6+} can be virtually eliminated and that from V^{5+} halved by an extraction of the Nb complex with ethyl acetate. Ta accompanies Nb but, by selection of the wavelength, interference from moderate amounts can be minimized. Interference by Ti is very serious but somewhat less than in the original procedure of Hunt and Wells. (auth)

16328 IMPROVED DETERMINATION OF TANTALUM BASED UPON THE PYROGALLOL PROCEDURE. José A. Catoggio and L. B. Rogers (Massachusetts Inst. of Tech., Cambridge). Talanta, 9: 387-92 (Apr. 1962). (In English)

The pyrogallol method for Ta was improved in two ways. First, the addition of boric acid eliminates the interference from fluoride. Second, incorporation of an extraction with ethyl acetate, in the presence of a long-chain quaternary ammonium ion, eliminates the interference from V^{5+} and decreases that from Cr^{6+}. Ti^{4+}, Mo^{6+}, and W^{6+} remain as interferences. (auth)

16329 ION-EXCHANGE SEPARATIONS USING SULPHOSALICYLIC ACID. James S. Fritz and Thomas A. Palmer (Ames Lab., Ames, Iowa). Talanta, 9: 393-7 (Apr. 1962). (IS-382). (In English)

Ion-exchange separation of metal cations is carried out by elution from a 4- to 8-cm cation-exchange column with sulfosalicylate at pH 6 to 7. Al^{3+}, Fe^{3+}, Ti^{4+}, U^{6+}, V^{4+}, and Zr^{4+} are quantitatively eluted, and Th^{4+} and Cu^{2+} are partly eluted. Other bivalent metal ions and rare earths are quantitatively retained by the column. (auth)

General Inorganic and Physical Chemistry

Refer also to abstracts 16048, 16075, 16087, and 16088.

16330 (AD-264708) ROTATIONAL STATES OF POLAR MOLECULES IN RARE GAS CRYSTALS: POINT DIPOLE APPROXIMATION. R. L. Armstrong (Johns Hopkins Univ., Baltimore. Radiation Lab.). Oct. 1961. Contract AF33(616)-6457. 26p. (WR-AF-2)

A study was made of the rotational states of small concentrations of polar molecules trapped in a rare gas lattice at low temperatures. The polar molecules were assumed to be effective point dipoles so that exchange forces were neglected. The dispersion interactions of each polar molecule with the rare gas host were found to be spherically symmetric, to a good approximation. Dipolar coupling was found to produce an effective rotational potential function at the site of each polar molecule. This potential, which acts as a small perturbation, was found to create a second order splitting of the free molecular rotational levels. Some numerical values of these splittings are given for the molecules HCl and PH_3. (auth)

16331 (CEA-1934) CONTRIBUTION A L'ÉTUDE DE LA RÉACTIVITÉ DU GRAPHITE VIS A VIS DU GAZ CARBONIQUE ET DE L'AIR. (Contribution to the Study of the Reactivity of Graphite with Respect to Carbon Dioxide and Air). Michel Jacquet (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 77p.

Thesis submitted to Nancy, Université.

The oxidation of nuclear-quality graphite by air and carbon dioxide was studied at temperatures at which the reaction becomes measurable. These experiments were carried out on graphites differing in the concentration and nature of their ash, and in their mode of preparation. The reaction velocities measured were compared in an attempt to correlate these two factors. Ten types of graphite were studied. Since the oxidation reactions are of the type gas-solid, their velocities were also compared to the BET surface areas of the graphite studied and to the diameter distribution of the pores of this surface. The conclusion is that, even for these low impurity contents, the law relating the reaction velocity to the surface is masked by the impurities which appear to behave as preferential reaction sites. This was shown by carrying out successive purifications on various types of graphite, which treatment results in an important decrease in the reactivity of all the samples studied. (auth)

16332 (CEA-2088) ETUDE DE LA FORMATION ET DE LA REPARTITION DES GAZ DISSOUS ET DE L'EAU OXYGENEE DANS L'EAU D'UN REACTEUR PISCINE (TRITON). (Study of the Formation and of the Distribution of Dissolved Gases and Hydrogen Peroxide in Water from a Swimming-Pool Reactor (Triton)). J. Chenouard, J. Rozenberg, L. Dolle, and G. Dirian (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 16p. (DPC-IS-SCI/61-343)

In order to determine experimentally the amount of radiolysis in the swimming-pool reactor Triton, direct measurements were made of the quantity of radiolysis gas and hydrogen peroxide in the water, at the entry and exit of the core. The concentration distribution of these gases in the reactor was also determined. An explanation is given as to why no gaseous evolution is seen in the swimming-pool reactors of the C.E.A. The over-all amount of radiolysis is zero, and a simple interpretation of this result is possible. The real amount of radiolysis occurring in the reactor core can be calculated. This is in satisfactory agreement with certain measurements made elsewhere. (auth)

16333 (CEA-2106) ETUDE DES COMPOSES $UO_2F_2-H_2O-HF$. (Study of $UO_2F_2-H_2O-HF$ Compounds). G. Neveu (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 19p.

Various compounds resulting from the interaction of UO_2F_2 with H_2O and HF (gas) and various triple compounds $UO_2F_2-H_2O-HF$ were studied. The conditions of decomposition and the thermodynamic limits of stability are specified. (auth)

16334 (CEA-2110) CONTRIBUTION A L'ETUDE DES REACTIONS DE L'HEXAFLUORURE D'URANIUM AVEC QUELQUES HALOGENURES METALLIQUES. (Contribution to the Study of the Reactions of Uranium Hexafluoride with Some Metallic Halides). Michel Michallet (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 67p.

Thesis submitted to Université, Lyon.

A metallic difluoride is inert to UF_6 unless the metal can exist in a higher valency state. In this case, UF_6 acts as an oxidizing agent and is transformed into UF_4. The fluorides of tri- and tetra-valent metals give rise to new compounds when they are maintained at a high temperature (500°C) in the presence of uranium hexachloride vapor. The products obtained were characterized by their x-ray diffraction diagrams. The distributions of the lines of the powder diagrams were very similar to that of U_4F_{17}. Assuming that this resemblance is due to a stacking of identical fluorine atoms, it was calculated that the corresponding structure is given by the theoretical equation $MeF_3 + 0.562\ UF_6$ —

$MeF_4 + 0.396\ UF_6$ which is in good agreement with chemical measurements. (auth)

16335 (DP-678) MINIATURE PURIFICATION PROGRESS REPORT. I. DESCRIPTION OF EQUIPMENT, TESTS Ia, Ib, and II. Elizabeth W. Baumann (Du Pont de Nemours (E. I.) and Co. Savannah River Lab., Aiken, S. C.). Feb. 1962. Contract AT(07-2)-1. 46p.

Ion exchange studies of the D_2O from a Savannah River production reactor were made by means of an out-of-pile loop. The loop and the results of several tests are described. (auth)

16336 (HW-69692) THE RELEASE OF RADIOSTRONTIUM FROM STRONTIUM CARBONATE. D. L. Reid, R. K. Hilliard, and L. F. Coleman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1, 1961. Contract AT(45-1)-1350. 10p.

A study of the release of radiostrontium from strontium carbonate was made in support of hazard evaluations associated with an accidental firing or spilling of the material during transportation. Tests were planned to differentiate between the effects of temperatures up to 1500°C and air entrainment of the minute particulates, and to obtain size distribution data of the primary and agglomerated particles. The results show that both high temperature volatilization and particle entrainment by the gas stream are involved in the release. A particle size analysis of the material used for testing showed it to be an agglomerated mass consisting primarily of 1 to 3 μ diameter crystallites. Air dispersion of the material resulted in a median particle diameter within the 1 to 4 μ size range; alcohol dispersion gave a median particle diameter in the 4 to 12 μ range. (auth)

16337 (NBS-MON-32(Pt.II)) TABLES OF SPECTRAL-LINE INTENSITIES. PART II. ARRANGED BY WAVELENGTHS. William F. Meggers, Charles H. Corliss, and Bourdon F. Scribner (National Bureau of Standards, Washington, D. C.). Oct. 2, 1961. 271p.

The relative intensities, or radiant powers, of 39,000 spectral lines with wavelengths between 2000 and 9000 Å were determined on a uniform energy scale for seventy chemical elements. This was done by mixing 0.1 at. % of each element in powdered copper, pressing the powder-mixture to form solid electrodes which were burned in a 10 ampere, 220 volt direct-current arc, and photographing the spectra with a stigmatic concave grating while a step sector was rotating in front of the slit. The sectored spectrograms facilitated the estimation of intensities of all element lines relative to copper lines which were then calibrated on an energy scale provided by standardized lamps, and all estimated line intensities were finally adjusted to fit this calibration. Comparisons with other intensity measurements in individual spectra indicated that the National Bureau of Standards spectral-line intensities may have average errors of 20%. They provide uniform quantitative values for the seventy chemical elements commonly determined by spectrochemists. All 39,000 observed lines are given in order of wavelength. (auth)

16338 (NPCC/MWP(G)P180) AN INTERIM REPORT ON STUDIES OF THE REACTIVITY OF REACTOR GRADE GRAPHITE AND OTHER CARBONS. P. A. H. Tee (British Coal Utilisation Research Assn., Leatherhead, Surrey, England). Sept. 1961. 49p.

The techniques developed for determining the reactivity of pile graphite grade "A" and other carbonaceous materials toward oxidizing gases are described. The results obtained are being used in conjunction with a parallel investigation of the capillary structure of these materials with the view to relating pore structure and oxidation behavior. (auth)

16339 (TID-15369) APPLICATIONS OF RADIOISOTOPES TO CHEMICAL PROBLEMS. Progress Report, March 1, 1961–March 1, 1962. (Wisconsin. Univ., Madison). Mar. 1, 1962. Contract AT(11-1)-32. 17p.

The effects of subsequent gamma irradiation and thermal annealing on the aqueous yield of Br^{82} produced by the $Br^{81}(n,\gamma)$ reaction in C_2Br_6 were studied; the results indicate the aqueous yield to be made up of three components with different annealing rates. Production of Br_2 by gamma irradiation of C_2Br_6 was also studied. Evidence is reported for the mechanism of n-C_3H_7Cl radiolysis. Studies of the photochemical reactions of I_2 vapor with C_3H_8 gas indicate that the reaction is of an I atom with an I atom-C_3H_8 complex. The electron spin resonance spectra of solid solutions of I_2 in C_2H_5OH, $C_2H_5OC_2H_5$, and iso-C_3H_7OH glass at 77°K are examined. Results of studies of radiolysis of solutions of alkyl iodides in hydrocarbons are described; the results support the importance of the reaction $RI + e^- \rightarrow R + I^-$. Electron spin resonance was used to study irradiated C_2H_5I, C_2H_5Br, and C_2H_5Cl at 44 and 7°K, and a survey of the stable products in the radiolysis of these three compounds in the liquid, polycrystalline, and glassy phases indicate that the same products are formed in all three phases. (D.L.C.)

16340 (TID-15370) THE EFFECT OF OXYGEN PRESSURE ON THE OXIDATION OF CHROMIUM. Technical Progress Report, March 1, 1961–February 28, 1962. Richard E. Grace (Purdue Univ., Lafayette, Ind. School of Metallurgical Engineering). Mar. 13, 1962. Contract AT(11-1)-776. 13p.

The oxidation of Cr in damp H_2 at a total pressure of 1 atm was studied at temperatures from 700 to 900°C and at dew points from −48 to +13°C. The initial oxidation rate is linear for 10 to 25 min, followed by parabolic film growth for several hours. The oxidation product formed in both O_2 and damp H_2 is Cr_2O_3. The activation energies for parabolic growth in damp H_2 are 50 to 60 kcal/mole. The growth rate is sensitive to the dew point and temperature of the oxidizing gas. (D.L.C.)

16341 (FTD-TT-61-409) SILICIDES AND THEIR USES IN ENGINEERING. G. V. Samsonov. Translation of "Silitsidy i ikh Ispol'zovanie v Tekhnike" (a publication of the Academy of Sciences, Ukrainian SSR, Kiev, 1959). 270p.

Information concerning specific silicides is presented. Also included is information on Si-containing systems in general. No information is included on preparation and purification of elementary Si or on compounds of Si with H, O, and the halogens. (J.R.D.)

16342 (FTD-TT-62-46) INVESTIGATION OF FUSED SALTS BY MEANS OF RADIOACTIVE RADIATION. A. I. Belyaev (Belyayev). Translated from Izvest. Vysshikh Ucheb. Zavedeniĭ, Tsvetnaya Met., No. 6, 46-54(1960). 17p.

Results of an investigation on the absorption of gamma radiation in fused salts are presented. Of particular interest are the physicochemical properties of systems used in aluminum electrolyte baths and the use of radiometry to determine the composition of fused salts. Gamma radiation absorption results are correlated with Z values. (J.R.D.)

16343 (NASA-TT-F-88) CERTAIN PROBLEMS RELATED TO THE VISCOSITY OF FUSED METALS. E. (Ye.) G. Shvidkovskii (Shvidkovskiy). Translation of "Nekotorye Voprosy Vyazkosti Rasplavlennykh Metallov" (a publication of the State Publishing House for Technical and Theoretical Literature, Moscow, 1955). 201p.

The theory of the torsional oscillation method for measuring the viscosity of liquids and experimental technical problems associated with the use of this method were examined. The results obtained during the measurement of the viscosity of fused metals and alloys are presented. A theoretical interpretation is given of certain problems concerned with the nature of the liquid state (structure of the liquid, mechanism of the viscous flow, kinetics of crystallization, the effect of insoluble impurities on the viscosity, etc.). (auth)

16344 DEUTERIUM EXCHANGE REACTIONS WITH SUBSTITUTED AROMATICS. III. HETEROCYCLICS AND POLYCYCLIC HYDROCARBONS. J. L. Garnett and W. A. Sollich (Univ. of New South Wales, [Sydney]). Australian J. Chem., 15: No. 1, 56-64(Feb. 1962).

Platinum-catalyzed deuterium exchange reactions between heavy-water and polycyclic aromatics and heterocyclics were investigated. The results confirm a charge-transfer-no-bond adsorption mechanism for catalytic chemisorption. Degree of catalyst poisoning increases with decreasing ionization potential for aromatic molecules of similar complexity, such as anthracene and phenanthrene. As the number of nodal planes in the bonding orbitals of the more complex polycyclic aromatics increases, a decrease is observed in catalyst poisoning. Exchange of pyridine is slower than benzene and this is attributed to an additional interaction of the pyridine molecule with the catalyst through its lone-pair of electrons. The reactivity of n-octane supports the extension of the π-complex chemisorption theory to molecules possessing only σ-electrons. Anisole, cyclohexane, nitrobenzene, cyclohexene, and phenyl cyanide exchange in an anomalous manner. (auth)

16345 STRUCTURE OF THE BAND SPECTRUM OF CuCl MOLECULE. II. ROTATIONAL STRUCTURE OF THE F-X BAND SYSTEM OF $Cu^{65}Cl^{35}$. P. Ramakoteswara Rao (Atomic Energy Establishment, Trombay, India), R. K. Asundi, and J. K. Brody. Can. J. Phys., 40: 412-22(Apr. 1962).

The F-X band system of $Cu^{65}Cl^{35}$ extending from 3700 to 4200 Å was photographed in emission under high resolution. Rotational analysis of the (3,0), (2,0), (1,0), (0,0), (0,1), and (0,2) bands of the system was made. The electronic transition involved is $^1\Pi$-$^1\Sigma$. The Λ-type doubling in the $^1\Pi$ state is negligible. The principal molecular constants obtained are as follows (cm^{-1} units) F $^1\Pi$ state: $T_e = 25285.30$; $B_e = 0.1608$; $\alpha_e = 9.1 \times 10^{-4}$; $D_e = 1.2 \times 10^{-7}$; $\omega_e = 384.94$; $\omega_e x_e = 1.65$; and X $^1\Sigma$ state: $B_e = 0.1764$; $\alpha_e = 10.0 \times 10^{-4}$; $D_e = 1.3 \times 10^{-7}$; $\omega_e = 415.29$; $\omega_e x_e = 1.58$. (auth)

16346 STRUCTURE OF THE BAND SPECTRUM OF CuCl MOLECULE. III. ROTATIONAL STRUCTURE OF THE B AND C SYSTEMS OF $Cu^{65}Cl^{35}$. P. Ramakoteswara Rao (Atomic Energy Establishment, Trombay, India), R. K. Asundi, and J. K. Brody. Can. J. Phys., 40: 423-30(Apr. 1962).

The B and C band systems of $Cu^{65}Cl^{35}$ lying in the region 4600 to 5200 Å were photographed in emission under high resolution. Rotational analysis of the (1,0), (0,0), and (0,1) bands of each system was made. The analysis shows that the B and C systems involve transitions $^1\Pi(B\ ^1\Pi)$-X $^1\Sigma$ and $^1\Sigma(C\ ^1\Sigma)$-X $^1\Sigma$ respectively. Due to the influence of the closeby C $^1\Sigma$ state, the B $^1\Pi$ state shows appreciable Λ-type doubling. It is found that the B $^1\Pi$ and C $^1\Sigma$ states provide an instance closely resembling the case of Van Vleck's "pure precession." The principal molecular constants obtained for the initial states of the B and C systems of $Cu^{65}Cl^{35}$ are as follows (cm^{-1} units): B $^1\Pi$ state: $T_e = 20484.0$; $B_e = 0.1688$; $\alpha_e = 9.2 \times 10^{-4}$; $D_e = 1.2 \times 10^{-7}$; $q_0 = -8.7 \times 10^{-4}$; and C $^1\Sigma$ state: $T_e = 20630.8$; $B_e = 0.1700$; $\alpha_e = 8.9 \times 10^{-4}$; $D_e = 1.2 \times 10^{-7}$. (auth)

16347 EXCHANGE PROPERTIES OF ZIRCONIUM PHOSPHATE. Jacques Prospert and Tivadar Kikindai (Centre d'Études Nucléaires, Saclay, France). Compt. rend., 254: 860-2(Jan. 29, 1962). (In French)

The possibilities for the utilization of zirconium phosphate as an ion exchanger were studied; the exchange properties with respect to cations and anions and the solubility of the phosphate in acids were determined. (tr-auth)

16348 THE KINETICS OF THE OXIDATION OF MAGNESIUM IN HUMID OXYGEN AT HIGH TEMPERATURES. Raymond Darras, Jean Païdassi, and Francis Leroy (Centre d'Études Nucléaires, Saclay, France). Compt. rend., 154: 869-71(Jan. 29, 1962). (In French)

In the interval from 350 to 600°C, the oxidation of magnesium in oxygen saturated with water vapor at 25°C obeys a linear law, and the reaction product is constituted exclusively by cubic magnesium oxide with normal crystalline parameters. The oxidation processes can be characterized in the intervals from 350 to 550 and from 550 to 600°C by two activation energies, 26,200 and 45,200 cal/mole, respectively. (tr-auth)

16349 THE EXISTENCE AND SOME PROPERTIES OF THE NEUTRAL TELLURITE OF TETRAVALENT URANIUM $U(TeO_3)_2$. Parviz Khodadad (Laboratoire de Chimie Minérale, Faculté de Pharmacie, Paris). Compt. rend., 254: 1079-81(Feb. 5, 1962). (In French)

The method for the preparation of $U(TeO_3)_2$ is indicated; the product is amorphous. The study of the chemical properties puts in relief the reaction of intramolecular oxyreduction, in which one of the products is also an equally new compound, uranyl tellurite. (tr-auth)

16350 THE STRUCTURE AND THE PROPERTIES OF PHASES FORMED DURING THE ACTION OF AMMONIA ON ZIRCONIA. Jean-Claude Gilles and Robert Collongues (Centre National de la Recherche Scientifique, [Paris]). Compt. rend., 254: 1084-6(Feb. 5, 1962). (In French)

Zirconium oxide (ZrO_2) is inert with respect to the majority of gaseous atmospheres up to very high temperatures. The present studies show, however, that ZrO_2 has a high sensitivity to the action of ammonia. During this reaction, several new phases, which are the oxynitrides of zirconium, appear. (tr-auth)

16351 CONTINUOUS MEASUREMENT OF DIFFUSION COEFFICIENTS OF GASES IN LIQUIDS USING GLASS SCINTILLATORS. L. H. Bodnar and D. M. Himmelblau (Univ. of Texas, [Austin]). Intern. J. Appl. Radiation and Isotopes, 13: 1-6(Jan. 1962). (In English)

Glass scintillators were used to measure the diffusion of $C^{14}O_2$ in water in a sealed diffusion capillary. These scintillators, while only 10% as efficient as plastic scintillators for C^{14} particles, are relatively inert and non-absorbing. By employing radioactive tracers and standard counting equipment, it was possible to monitor the slow process of diffusion for as long as several hundred hours without disturbing the system by sampling. The diffusion coefficient obtained at 30°C for carbon dioxide agreed with previous coefficients. (auth)

16352 DISSOCIATION PRESSURE OF URANIUM DICARBIDE. James M. Leitnaker and Willard G. Witteman (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys., 36: 1445-52(Mar. 15, 1962).

Vapor transport of uranium from $UC_{1.86}$ in a graphite crucible was measured from 1930 to 2365°K by the Knudsen technique. In order to treat the data, unusual assumptions were made concerning the thermal properties of carbides which hydrolyze to yield hydrocarbons. The gaseous uranium species is assumed to be monatomic. With the aid of these assumptions, the data were treated by the third-law as well as by the second-law method. Agreement between the two is considered good, and the $\Delta H_{298}°$ obtained for the process $UC_{1.86}(s) = U(g) + 1.86$ C (graphite) is 140.15 ± 1.82 kcal/mole. Reasonable estimations for reaction entropies within the system lead to an upper limit of 0.5 kcal/mole for $\Delta H_{298}°$ for the reaction $UC(s) + 0.86$ C (graphite) = $UC_{1.86}(s)$, and hence a value of 119.8 ± 2.8 kcal/mole is obtained as an upper limit for $\Delta H_{298}°$ of vaporization of uranium. (auth)

16353 INTERACTION ENERGY OF AN ALKALI METAL WITH A RARE GAS. Nivard Scheel and Virginia Griffing (Catholic Univ. of America, Washington, D. C.). J. Chem. Phys., 36: 1453-8(Mar. 15, 1962).

A molecular orbital self-consistent field calculation is made for closed shell ions, $LiHe^+$ and $LiHe^-$ as function of internuclear distance. The eigenfunctions obtained from these calculations were used to calculate the potential energy curves for the neutral Li−He. This system has some interesting properties. For example, these calculations suggest the probable quenching of certain excited states of an alkali metal when in close interaction with a rare-gas atom. All of the curves obtained are repulsive except for the $LiHe^+$ curve which has a shallow minimum and follows an expected $1/r^4$ attractive potential. Fair values are obtained for the ionization energies of the Li and He atoms and the electron affinity of Li. These calculations indicate that open-shell systems with few electrons can be treated by making the simpler SCF calculation on a closely related closed-shell system and using the resulting eigenfunctions to calculate the energy of the closed shell system. (auth)

16354 NUCLEAR QUADRUPOLE RESONANCE OF N^{14} IN SOLID N_2. T. A. Scott (Univ. of Florida, Gainesville). J. Chem. Phys., 36: 1459-65(Mar. 15, 1962).

Pure quadrupole resonance of N^{14} in the α phase of solid nitrogen was studied in the temperature range from 1.5 to about 34.5°K. The resonance frequency at 4.2°K is 3.4873 ± 0.0001 Mc. The line shape and relaxation times at 4.2°K are discussed. A hydrostatic compression to 130 atm at 4.2°K gives $(d\nu/dP)_{4.2} = 33$ cps/atm. The temperature dependence of the resonance frequency below 20°K was analyzed in terms of a modified Bayer theory in which account is taken of volume expansion. The torsional frequency of oscillation of the molecule is found to be $\nu_t = 1.12 \times 10^{12}$ sec^{-1}, and the quadrupole resonance frequency without zero-point vibrations is $\nu_0 = 4.16$ Mc. The resonance frequency decreases very rapidly as the phase transition at 35.6°K is approached and pure quadrupole resonance was not observed in the β phase. (auth)

16355 HYPERFINE STRUCTURE OF THE ROTATIONAL SPECTRUM OF HDO. E. B. Treacy and Yardley Beers (New York Univ., New York). J. Chem. Phys., 36: 1473-80(Mar. 15, 1962).

The hyperfine structure of the $3_2 \rightarrow 3_3$ and $5_2 \rightarrow 5_3$ rotational transitions of HDO, which fall at about 825 and 487 Mc, respectively, were studied using microwave cavities as spectrometers. The experiments illustrated the usefulness of large Q cavities as spectrometers for this kind of work. The $3_2 \rightarrow 3_3$ transition was resolved into a symmetrical pattern consisting of a strong central line with six weak satellites on each side. The minimum full linewidth between half-power points that was achieved was about 10 or 12 kc. The spectrum was fitted with $C_H = -46.6 \pm 0.3$ kc, $C_D = -1.66 \pm 0.3$ kc, and $(eqQ)_{OD} = 310.3 \pm 3$ kc. The $5_2 \rightarrow 5_3$ transition was resolved into a symmetrical pattern also, with a strong central line and three weak satellites on each side. The minimum full linewidth between half-power points was about 6 kc. The spectrum was fitted with $C_H = -47.38 \pm 0.1$ kc, $C_D = -2.42 \pm 0.1$ kc, and $(eqQ)_{OD} = 314.3 \pm 1.5$ kc. A systematic comparison of the results with those obtained elsewhere on the $2_1 \rightarrow 2_2$ transition in HDO is made. The qualitative features of the spectra are consistent with what one would expect on the basis of existing theory, but the present state of the theory may be inadequate for explaining some of the quantitative details of the magnetic structure. (auth)

16356 ELECTROSTATIC ENERGY MATRICES OF THE f^7 CONFIGURATION. W. A. Runciman (Univ. of Canterbury, Christchurch, N. Z.). J. Chem. Phys., 36: 1481-9(Mar. 15, 1962).

The f^7 electrostatic matrices were derived by the methods of Racah and are tabulated. A previous table of spin-orbit matrix elements was corrected and extended, and then used in a further analysis of the spectra of gadolinium salts. Finally, a tentative calculation was made of the energy levels for the corresponding curium salts. (auth)

16357 ISOTOPE EFFECTS AND ELECTRONIC ENERGY IN MOLECULES. Anders Froeman (Univ. of Uppsala). J. Chem. Phys., 36: 1490-5(Mar. 15, 1962).

The definition of electronic energy in molecules is analyzed and, in its conventional form, it is shown to be in slight disagreement with experimental experience. By means of a proper treatment of the center-of-mass motion, a modified concept called reduced electronic energy is introduced and shown to give more satisfactory results. In particular, the hydrogen molecule and its isotopic analogues are used for a quantitative comparison of the two concepts with experimental results. (auth)

16358 ENTROPIES, HEATS OF SUBLIMATION, AND DISSOCIATION ENERGIES OF THE CESIUM HALIDES. Milton D. Scheer and Joseph Fine (National Bureau of Standards, Washington, D. C.). J. Chem. Phys., 36: 1647-53(Mar. 15, 1962).

The vapor pressures of the crystalline cesium halides were measured in the 700−900°K temperature range. The salt vapor effusing from a Knudsen effusion cell was accurately collimated into a molecular beam with a well-defined cross-sectional area. Beam intensities were determined from the positive ion currents produced by dissociation of the halide and ionization to Cs^+ on a tungsten surface at 1700°K. From the experimental vapor pressures and heats of sublimation, the crystal entropies, dissociation energies, and heats of sublimation at 298°K were computed using available spectroscopic and thermal data. (auth)

16359 ESR SPECTRUM AND STRUCTURE OF THE FORMYL RADICAL. Frank J. Adrian, Edward L. Cochran, and Vernon A. Bowers (Johns Hopkins Univ., Silver Spring, Md.). J. Chem. Phys., 36: 1661-72(Mar. 15, 1962).

Electron spin resonance (ESR) spectra of the formyl radical (HCO) and deuterated radical (DCO) were observed in solid carbon monoxide over the temperature range 4.2 to 30°K. The observed line shapes were temperature dependent, but the cause of the temperature dependence was not definitely determined. The radical was produced by the reaction of CO with hydrogen atoms produced by the photolytic decomposition of HI. The radical was also produced by the photolytic decomposition of formaldehyde in solid argon, and it was found to be one of the products of the photolysis of methyl alcohol in solid argon. The most striking feature of the ESR spectrum of HCO is the very large proton hyperfine splitting (137 gauss). Also the lines were broad and unsymmetrical with the linewidth varying from one hyperfine component to the next. It was shown that the line shapes were due to the combination of a rather pronounced anisotropy in the electronic g factor with a smaller anisotropy in the proton hyperfine interaction. These characteristics of the radical gave a good deal of information about its structure which supported the conclusion of others that the formyl radical is not a π-electron radical. (auth)

16360 NUCLEAR QUADRUPOLE RESONANCE OF As^{75} IN $Na_2HAsO_4 \cdot 7H_2O$. Eric D. Jones and Edwin A. Uehling (Univ. of Washington, Seattle). J. Chem. Phys., 36: 1690-1 (Mar. 15, 1962).

The As^{75} pure nuclear quadrupole resonance was observed at room temperature and 77°K in $Na_2HAsO_4 \cdot 7H_2O$ (sodium arsenate). The frequency is approximately 44.2 Mc at the higher temperature and decreases by almost 2 Mc in going to the lower temperature. Using a Zeeman field of approximately 100 gauss and a quench frequency of 50 kc the observed resonance was not completely resolved by the sideband responses of the super-regenerative spectrometer at room temperature, but it was more nearly resolved at 77°K. This indicates a linewidth $\Delta\nu \sim 50$ kc which decreases appreciably with decreasing temperature. There was no indication of change in linewidth between polycrystalline and single crystal samples. (P.C.H.)

16361 NUCLEAR MAGNETIC RESONANCE OF ARSENIC AND ANTIMONY IN LIQUID AsF_5 AND $SbCl_5$. Eric D. Jones and Edwin A. Uehling (Univ. of Washington, Seattle). J. Chem. Phys., 36: 1691(Mar. 15, 1962).

Nuclear magnetic resonances of arsenic and antimony were observed in liquid AsF_5 and $SbCl_5$ at room temperature. The linewidth of the As^{75} NMR was approximately 15 gauss with no evidence of structure in the resonance. The NMR of both Sb^{121} and Sb^{123} were easily observed. The observed linewidth for Sb^{121} resonance was approximately the same as As^{75}. Searches were made at 11 Mc for the Sb^{121} NMR in solid $SbCl_5$ at 0°C and also for pure quadrupole resonances at 77°K with negative results in both cases. The frequency range covered was 6 to 190 Mc. (P.C.H.)

16362 GRANULOMETRIC ANALYSIS OF PHOTOGRAPHIC EMULSIONS. Roger Audran, Michèle Engelen, and Alain D. Jouy (Laboratoires de Recherches Kodak-Pathe, Vincennes, France). J. chim. phys., 59: 55-62(Jan. 1962). (In French)

A sedimentation method for the determination of the granulometric distributions was adapted to the case of photographic emulsions. The method permits the representative curve of an emulsion to be obtained rapidly with a reproducibility higher than 5%. The curves are traced by carrying the quantity of silver as a function of the crystal diameter. The prospects of this procedure are briefly discussed. (tr-auth)

16363 A KINETIC STUDY OF THE ISOTOPIC EXCHANGE OF GALLIUM BETWEEN THE GALLIUM ION AND GALLIUM ETHYLENEDIAMINE-N,N,N',N'-TETRAACETATE AND N-2-HYDROXYETHYL ETHYLENEDIAMINE-N,N',N'-TRIACETATE IN WATER. K. Saito and M. Tsuchimoto (Tokyo Univ.). J. Inorg. & Nuclear Chem., 23: 71-9(Dec. 1961). (In English)

Isotopic exchange of gallium between the gallium ion and its EDTA and EDTA–OH complexes is immeasurably slow in neutral solution and very fast in basic and strongly acid solutions. The rate is measurable in the pH regions near 8 and 1, and the rate constant for exchange is independent of the concentration of uncomplexed gallium and proportional to that of the complex. Near pH 8, the rate constant is proportional to the concentration of OH^- ion, and the Arrhenius activation energy is ~26 kcal mole^{-1} for both complexes. Below pH 1, the rate constant is proportional to $[H^+]^{2.4}$ and the apparent Arrhenius activation energy is much smaller (~15 kcal mole^{-1}). It appears that the mechanism of exchange is different in these two pH regions, although it seems to be similar for both complexes under given conditions. (auth)

16364 THE OXIDATION-REDUCTION POTENTIAL OF $UO_2^{2+}-U^{4+}$ SYSTEM. II. THE INFLUENCE OF $HClO_4$, HCl, H_2SO_4 AND OF TEMPERATURE ON THE OXIDATION POTENTIAL OF $UO_2^{2+}-U^{4+}$. J. Sobkowski (Univ. of Warsaw). J. Inorg. & Nuclear Chem., 23: 81-90(Dec. 1961). (In English)

Oxidation-reduction potentials of $UO_2^{2+}-U^{4+}$ were investigated in perchloric, hydrochloric, and sulfuric acids at various temperatures. The values of the standard redox potentials differ in the various media due to complex formation. From the change of redox potential with temperature the entropy of U^{4+} ion was calculated. The value is lower in H_2SO_4 than in $HClO_4$ solution, due to complex formation. (auth)

16365 OBSERVATIONS ON THE PROPERTIES OF PROTACTINIUM(V) IN SULPHURIC ACID SOLUTION. D. Brown, T. Sato, A. J. Smith, and R. G. Wilkins (The University, Sheffield, Eng.). J. Inorg. & Nuclear Chem., 23: 91-101(Dec. 1961). (In English)

Absorption spectra of protactinium(V) in sulfuric acid of various concentrations were obtained. Only one peak was observed and this shifted continuously from 206 to 222 mμ with increasing acidity. A plateau was noted between 280 and 300 mμ for solutions of low acidity and this is believed to be associated with hydrolysis products. Observations were made on the stability of protactinium(V) in all these solutions. Ion exchange studies were coupled with solvent extraction data to provide information on the nature of the complexes in solution. The results suggest that species of charge −1 exist in equilibrium with cationic species over the range 0.1 to 0.5 M sulfuric acid, while at higher acidities further complexing takes place to produce species of charge 3−. (auth)

16366 STERIC EFFECTS IN SOLVENT EXTRACTION OF YTTRIUM AND LANTHANUM BY HYDROGEN 2-ETHYLHEXYL PHENACYLPHOSPHONATE. C. G. Warren (Western State Coll., Gunnison, Colo.). J. Inorg. & Nuclear Chem., 23: 103-8(Dec. 1961). (In English)

Solvent extraction techniques were used to study the effect of steric crowding at the central metal atom for compounds formed from lanthanum or yttrium and hydrogen 2-ethylhexyl phenacylphosphonate. Compounds tentatively identified were YR_3, YHR_4, LaR_2, and $LaHR_4$. The solvate of the lanthanum chelate was formed more easily than the corresponding yttrium compound. (auth)

16367 SOME OBSERVATIONS ON Pu(IV)-ALKALI DOUBLE CHLORIDES. R. Benz and R. M. Douglass (Los Alamos Scientific Lab., N. Mex.). J. Inorg. & Nuclear Chem., 23: 134-6(Dec. 1961). (In English)

Mixtures of $PuCl_3$ and the alkali chlorides, in the mole ratio 1 : 2, were melted and saturated with chlorine at 0.80 atm pressure and approximately 50°C above the melting point. No reaction of chlorine with the solution $PuCl_3 + 2LiCl$ was detected. Products of reaction of chlorine with solutions of $PuCl_3 + 2NaCl$ and $PuCl_3 + 2RbCl$ are optically isomorphous with Cs_2PuCl_6. Products of reaction of chlorine with the solution $PuCl_3 + 2KCl$ are too fine grained to establish the isomorphism with certainty. The common reaction must be $PuCl_3(l) + 2MCl(l) + \frac{1}{2}Cl_2(g) = M_2PuCl_6(l)$; where M = Na, K, Rb, or Cs. Ranges of the non-stationary arrests indicate that the compounds containing Na and K, and probably the Rb compound, are partly dissociated under the given conditions and that the stabilities of the M_2PuCl_6 compounds increase in the order Na, K, Rb, and Cs. Results are believed to confirm the opinion that appreciable quantities of Pu(IV) may be formed in binary solutions of most alkali chlorides with $PuCl_3$ when exposed to chlorine gas. (P.C.H.)

16368 SPECTROPHOTOMETRIC STUDIES OF URANIUM(VI)-3-ACETYL-4-HYDROXYCOUMARIN COMPLEX IN ETHANOL. A. N. Bhat and B. D. Jain (Univ. of Delhi). J. Inorg. & Nuclear Chem., 23: 136-9(Dec. 1961). (In English)

A spectrophotometric study of the uranium(VI)-3-acetyl-4-hydroxycoumarin complex was made in about 95% ethanol. The complex was found to have a molar composition of 1:1 and obeys Lambert-Beer's law at 380 mμ in the range of 0 to 57.0 ppm of uranium. The presence of a hydrogen bonded system in the molecule was confirmed by the infrared spectrum of the compound in chloroform, which showed a diffused absorption band at 3080 cm^{-1} and a shift in the acetyl carbonyl frequency to 1625 cm^{-1}. (P.C.H.)

16369 ISOLATION OF NATURALLY OCCURRING TECHNETIUM. B. T. Kenna and P. K. Kuroda (Univ. of Arkansas, Fayetteville). J. Inorg. & Nuclear Chem., 23: 142-4(Dec. 1961). (In English)

About 1 m μg of Tc^{99} was isolated from several kg of Belgian Congo pitchblende. The amount of Tc found in the ore appears to be in good agreement with the calculated value. The analytical procedure for the dissolution of the pitchblende, removal of Cu, Mo, Re, and Ru, and the final isolation of Tc is given. Counting results of two separate samples are tabulated. (P.C.H.)

16370 SOME ASPECTS OF THE STOICHEIOMETRY OF $UO_{2.67}$ RELEVANT TO THE PREPARATION OF URANIUM ISOTOPIC STANDARDS, AND A REDETERMINATION OF THE URANIUM-235 CONTENT OF NATURAL URANIUM. B. R. Grundy and A. N. Hamer (United Kingdom Atomic Energy Authority, Capenhurst, Ches., Eng.). J. Inorg. & Nuclear Chem., 23: 148-50(Dec. 1961). (In English)

Weight changes in freshly prepared $UO_{2.67}$ were investigated during subsequent ignition at different temperatures. The composition of $UO_{2.67}$ (U_3O_8) was found to depend on the ignition temperature. When samples of oxide, freshly prepared by ignition at 800°C, are heated to 1000°C, they suffer a loss in weight, part of which is irreversible; during any subsequent thermal cycle within this temperature range, however, the weights obtained at any particular temperature are reproducible with a precision of ±0.005%. Thus, the stoichiometry of a sample of $UO_{2.67}$ does not depend on the chemical route by which it is made. In view of the investigations, the U^{235} abundance in natural uranium was redetermined. When the uncertainty inherent in the calculated compositions of the two blends was taken into account, the final value of the natural abundance of U^{235} was found to be 0.7196 ± 0.0003 at. %, equivalent to 0.7106 ± 0.0003 wt %. (P.C.H.)

16371 ISOTOPIC EXCHANGE IN GAS-CHROMATOGRAPHY. J. Tadmor (Israel Atomic Energy Commission Labs., Rehovoth). J. Inorg. & Nuclear Chem., 23: 158-9 (Dec. 1961). (In English)

Isotopic exchange by gas chromatography between the chlorine of volatile germanium(IV) and arsenic(III) chlorides and a Cl^{36} labeled liquid or solid phase was investigated. It was found that carrier-free labeled compounds can be obtained by this method, the exchange proceeding at a fast rate. Well defined single peaks of carrier-free germanium(IV) and arsenic(III) chlorides were obtained in the gas-solid chromatography experiments performed on Sil-O-Cel fire brick. Retention times were 30 sec and 2 min for the germanium tetrachloride and arsenic trichloride, respectively. (P.C.H.)

16372 THE BEHAVIOUR OF RUTHENIUM TRICHLORIDE IN AQUEOUS SOLUTIONS. Francesco Pantani (Università, Florence). J. Less-Common Metals, 4: 116-23(Apr. 1962). (In English)

Alkalimetric and argentometric titrations on the so-called ruthenium trichloride show the formation of hydroxycomplexes in aqueous solutions and mixtures of chlorohydroxy- and chloro-complexes in the presence of alkali chloride and HCl. Two absorption maxima are observed in the spectrum in the ranges of 390 and 460 mμ. The reduction to Ru(II) and a further reduction can be recorded polarographically, as well as the catalytic discharge of H+. The results are in agreement with the presence of ruthenium in the 4+ valency state. (auth)

16373 THE DISINTEGRATION OF BERYLLIUM DURING ITS DISSOLUTION IN HYDROCHLORIC ACID. M. E. Straumanis and D. L. Mathis (Univ. of Missouri School of Mines and Metallurgy, Rolla). J. Less-Common Metals, 4: 213-15(Apr. 1962). (In English)

Beryllium was reacted with acids such as hydrofluoric, hydrochloric, sulfuric, and perchloric. Each acid reacted rapidly but the nature of the attack differed considerably: hydrofluoric acid reacted with the metal surface evenly; something like a polishing effect was observed in sulfuric acid, and no black dispersion or deposit was obtained. On the other hand, the reaction with hydrochloric acid (0.5 N) was strongly localized, with striations across the grains, and a black deposit was observed, which separated from the beryllium. Perchloric acid reacted in a similar manner. No formation of a black deposit was observed in hydrochloric acid stronger than 0.5 N. Experiments performed with beryllium anodes in aqueous NaCl solutions showed that disintegration of the anode occurs even under such conditions. Thus, the appearance of a black dispersion while beryllium is dissolving in HCl, or anodically in NaCl solution, is due to the disintegration of the metal while the dissolution reaction occurs. (P.C.H.)

16374 CORRESPONDING STATES THEORY FOR ARGON AND XENON. F. Danon and Kenneth S. Pitzer (Univ. of California, Berkeley). J. Phys. Chem., 66: 483-5(Apr. 1962). (UCRL-9890)

Recent experimental results allow a more precise check than was previously possible on the conformity of argon and xenon to the principle of corresponding states. The data show agreement within experimental error except at very high pressures where small differences are found for some but not for other measurements. (auth)

16375 A RULE FOR THE CALCULATION OF THE ACTIVITY COEFFICIENTS OF SALTS IN ORGANIC SOLVENT-WATER MIXTURES. Herbert S. Harned (Yale Univ., New Haven). J. Phys. Chem., 66: 589-91(Apr. 1962).

Consideration of the properties of systems containing two electrolytes in water and in organic solvent—water mixtures leads to the conclusion that the ratio of the activity coefficients of the electrolytes at a given salt concentration and temperature is constant over a considerably range of composition of the solvent. Therefore, if the activity coefficient of one of the electrolytes is known in the organic solvent—water mixture, that of the second electrolyte may be computed from the activity coefficient ratio determined in aqueous solution. Since the activity coefficient of hydrochloric acid has been determined with high accuracy in many organic solvent–water mixtures, the above rule has a wide range of applicability. Comparison of results for lithium sodium, and potassium chlorides computed by the rule is made with those derived from amalgam cell measurements in methanol–water mixtures containing 10 and 20% methanol. The agreement is quite satisfactory. (auth)

16376 THE SECONDARY ISOTOPE RATE EFFECT IN THE IODIDE DEBROMINATION OF sym-TETRABROMOETHANE AND sym-TETRABROMOETHANE-d_2. Warren G. Lee and Sidney I. Miller (Illinois Inst. of Tech., Chicago). J. Phys. Chem., 66: 655-8(Apr. 1962).

For the iodide-promoted debromination of sym-tetrabromoethane and sym-tetrabromoethane-d_2, the secondary isotope rate factor $k_H/k_D \simeq 1.28$ at 81 to 111°. Over this temperature range, a decrease in k_H/k_D of about 6% was observed. The activation energies and entropies for the hydrogen and deuterium tetrabromoethanes are, respectively, 25.5 ± 0.5 and 26.2 ± 0.5 kcal mole^{-1} and −12.7 and −11.2 cal deg^{-1} mole^{-1}. A negative kinetic salt effect was observed. Calculations suggest that the observed value of k_H/k_D is characteristic of an elimination (E2) rather than a displacement (SN2) path for debromination. The rate data also appear to be more consistent with those from comparable E2 rather than SN2 systems. (auth)

16377 RARE EARTH DISILICIDES. I. P. Mayer, Ephraim Banks, and Ben Post (Polytechnic Inst. of Brooklyn). J. Phys. Chem., 66: 693-6(Apr. 1962).

Disilicides of yttrium and of a number of the heavier rare earth metals were prepared. X-ray diffraction analysis indicates that the yttrium compound is dimorphic, crystallizing in the hexagonal system (AlB_2 type) at low temperatures and in the orthorhombic system (distorted form of the tetragonal $ThSi_2$ structure) at higher temperatures. Tb and Ho disilicides are orthorhombic while the disilicides of Er, Tm, Yb, and Lu are hexagonal. The composition of the $YbSi_2$ phase was investigated by x-ray diffraction methods; within the limits of experimental error, the unit cell contains two silicon atoms for each ytterbium atom, as indicated by the formula. (auth)

16378 THE STRUCTURE OF LANTHANUM FAMILY SILICIDES. A. G. Tharp (Univ. of California, Berkeley). J. Phys. Chem., 66: 758-60(Apr. 1962).

Structures of disilicides of the higher atomic number lanthanum family elements, Er, Tm, Yb, and Lu, were compared. The four disilicides with the formula MSi_2 were found to crystallize in the hexagonal system. The atom positions are one metal atom in (0,0,0) and two silicon atoms in ± ($\frac{1}{3}, \frac{2}{3}, \frac{1}{2}$). It was also found that the structures of the MSi_2 phases are apparently not changed by varying the silicon composition. Calculated intensities were in good agreement with the observed intensities. The diffraction data and intensities for $ErSi_2$, $YbSi_2$, and $LuSi_2$ are in excellent agreement with that for $TmSi_2$, which are tabulated. The unit cell parameters and theoretical densities for the four disilicides are also tabulated. (P.C.H.)

16379 RETARDATION OF SINGLET AND TRIPLET EXCITATION MIGRATION IN ORGANIC CRYSTALS BY ISOTOPIC DILUTION. M. A. El-Sayed, M. T. Wauk, and G. W. Robinson (California Inst. of Tech., Pasadena). Mol. Phys., 5: 205-8(Mar. 1962).

The mixed crystal $C_{10}H_8$ in $C_{10}D_8$ provides a 100-cm^{-1} trap. A crystal of high chemical purity containing 0.5% $C_{10}H_8$ was studied in emission between 4.7 and 77°K on a 2-m grating spectrograph. Results and conclusions are listed. (L.N.N.)

16380 BASIC BERYLLIUM NITRATE. C. C. Addison and A. Walker (The University, Nottingham, Eng.). Proc. Chem. Soc., 242(July 1961).

Beryllium chloride undergoes solvolysis in ethyl acetate–dinitrogen tetroxide mixtures to give pale-straw crystals of the addition compound $Be(NO_3)_2$, $2N_2O_4$. When heated in a vacuum, this decomposes in two stages. Dinitrogen tetroxide is evolved rapidly above 500, leaving anhydrous beryllium nitrate, $Be(NO_3)_2$, as a white powder which has no detectable volatility. At about 125°, sudden decomposition occurs to give dinitrogen tetroxide and a volatile beryllium compound which separates from the gas phase as colorless crystals. Analyses correspond with the formula $Be_4O(NO_3)_6$ (found: Be, 8.5, N, 19.5. Calculated for $Be_4O(NO_3)_6$: Be 8.5; N 19.8%). The structure, which the basic nitrate is believed to possess, is given. The basic nitrate is analogous with basic beryllium acetate and properties of the two compounds are compared. (P.C.H.)

16381 NITRATONITROSYLRUTHENIUM COMPLEXES. D. Scargill and J. M. Fletcher (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Chem. Soc., 251(July 1961).

The potassium salt of the anion $[RuNO(NO_3)_3(H_2O)_2]^-$, the complex $[RuNO(NO_3)_3(H_2O)_2]$ in its anhydrous form, and the complex $[RuNO(NO_3)_3(Bu_3Po_4)_2]$ were prepared and their chemical compositions determined. The infrared spectra all show N–O stretching frequencies in the 1930 to 1950 cm^{-1} region: they also indicate, both by the large separation of the ν_1 (1263 to 1267 cm^{-1}) and ν_4 (1508 to 1530 cm^{-1}) frequencies and by the low values for ν_2, (952 to 970 cm^{-1}), the strong bonding character of the nitrato groups. (P.C.H.)

16382 COLOURED BIPYRIDYL COMPLEXES OF BERYLLIUM. G. E. Coates and S. I. E. Green (University Science Labs., Durham, Eng.). Proc. Chem. Soc., 376(Oct. 1961).

Evidence for electron transitions in o-phenanthroline and bipyridyl complexes of beryllium alkyls, aryls, and halides are reported. The colors of the bipyridyl complexes, $BipyBeX_2$, vary markedly from white to yellow to red with the electronegativity of X. It is suggested that the transition causing the colors is an electron transfer from one of the Be–X bonds to the lowest unoccupied orbital of bipyridyl. Yellow bipyridyl complexes of methyl zinc, cadmium, aluminum, and gallium were also prepared. The cadmium complex ($BipyCdMe_2$) is relatively unstable since it slowly decomposes into its components in vacuo at room temperature. Dimethyl-, diphenyl-, and di(phenylethynyl)-mercury do not form bipyridyl complexes. (P.C.H.)

16383 AlD BAND AT 2187Å. M. Aslam Khan (Univ. of Karachi, Pakistan). Proc. Phys. Soc. (London), 79: 745-8(Apr. 1, 1962).

An aluminum deuteride band at 2187 Å was observed and analyzed. The analysis showed that the band is analogous to the (1,0) band of AlH at 2173 Å belonging to the 2229 Å system. The following rotational constants are calculated: $B'_v = 3.162$ cm^{-1} and $D'_v = 1.53 \times 10^{-4}$ cm^{-1}, $B''_v = 3.283$ cm^{-1} and $D''_v = 0.97 \times 10^{-4}$ cm^{-1}, and $v_0 = 45{,}639.41$ cm^{-1}. (auth)

16384 THE GROUND STATE SPLITTING OF GADOLINIUM SULPHATE OCTOHYDRATE. G. S. Bogle and H. F. Symmons (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Phys. Soc. (London), 79: 775-86(Apr. 1, 1962).

The zero-field paramagnetic resonance frequencies of Gd^{3+} diluted in the sulfate octohydrates of yttrium, samarium, and neodymium were measured directly at 4.2, 80, and 273°K. The spin Hamiltonian is of the predominantly axial type and the energy levels inferred for pure gadolinium sulfate at 4°K are (in deg K): 0 ($S_z = \pm\frac{1}{2}$), 0.320 ($\pm\frac{3}{2}$), 0.710 ($\pm\frac{5}{2}$), and 1.257 ($\pm\frac{7}{2}$). Gd^{3+} in samarium sulfate is promising for a zero-field maser with an amplifying band extending from 7.8 to 8.5 Gc/s. The spin Hamiltonian deduced from traditional paramagnetic resonance is shown in one case to be reliable to within ±3% for predicting zero-field frequencies. (auth)

16385 SORPTION OF HELIUM AND NITROGEN ON VYCOR POROUS GLASS. D. F. Brewer and D. C. Champeney (Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 79: 855-68(Apr. 1, 1962).

Sorption isotherms of He^4 on Vycor porous glass were measured at temperatures between 1.7 and 4.22°K, and of nitrogen at 77.7°K. The helium adsorption is found to be anomalous when treated by standard Brunauer-Emmett-Teller theory. The data show that a part of the helium is abnormally dense, which may be represented by an underlayer adjacent to the substrate of thickness 4.8 Å and density 0.21 g cm^{-3}, equivalent to between one and two layers of solid density. These data are used to show that a modified theory, based on the assumption of a BET adsorption build-up on top of the basic first layer of approximately solid density, fits the results correctly up to 30% of saturation pressure. The theory is used to derive values of the heat of adsorption and density of the first modified BET layer, and of the isosteric heats of adsorption at higher coverages, which are compared with corresponding quantities in ordinary BET theory. The general character of the isotherms is similar to type IV of Brunauer's classification, with hysteresis. In helium, the size of the hysteresis loops is strongly dependent on temperature in a fashion not expected from a simple capillary condensation model. Hysteresis appears to be unaffected by the occurrence of superfluidity, but unexpectedly disappears at 4.22°K. From the desorption branch of the hysteresis loops, values of the pore radius r_K may be derived by application of the Kelvin vapor pressure equation. The values found are different for nitrogen and helium at different temperatures, but in all cases are much smaller than the radius $r_A = 35.4$ Å calculated from nitrogen adsorption with BET theory. Taken in conjunction with previous nitrogen measurements on Vycor, these results indicate a clear trend toward increasing discrepancies ($r_A - r_K$) with increasing pore radius. (auth)

16386 THE COHESIVE AND SURFACE ENERGIES OF SOME CRYSTALS POSSESSING THE FLUORITE STRUCTURE. G. C. Benson and E. Dempsey (National Research Council, Ottawa). Proc. Roy. Soc. (London), A266: 344-58 (Mar. 20, 1962). (NRC-6645)

Calculations of the cohesive and surface energies of CaF_2, SrF_2, and BaF_2 by methods based on the Born-Mayer model of an ionic crystal are described. The large effect, on the computed surface energy, of alterations in the approach to the cohesive energy calculation and of variations in the constants in the interaction potential is illustrated with reference to these crystals. (auth)

16387 IRON (III) MOLAR EXTINCTION COEFFICIENTS IN LIGHT AND HEAVY WATER SOLUTIONS. J. W. Boyle and H. A. Mahlman (Oak Ridge National Lab., Tenn.). Radiation Research, 16: 416-21(Apr. 1962).

The iron(III) molar extinction coefficient in H_2O–0.4 M H_2SO_4 solution at maximum absorption and 25°C, ϵ_s, was determined to be 2220 ± 20 liters $mole^{-1}$ cm^{-1}. The ratio of the iron(III) molar extinction coefficient in D_2O–0.4 M H_2SO_4 solution at maximum absorption and 25°C to ϵ_s was found to be 1.068 ± 0.004. The acidity effect is presented graphically, since the effect is nonlinear. The temperature coefficients were determined to be +(0.63 ± 0.02)% per degree centigrade for light water solutions and +(0.36 ± 0.02)% per degree centigrade for heavy water solutions. (auth)

16388 PROTACTINIUM STATE IN AQUEOUS CONDITIONS. IV. ADSORPTIVE PROPERTIES OF PROTACTINIUM. I. E. Starck, L. D. Sheidina, and L. I. Il'menkova. Radiokhimiya, 4: 44-9(1961). (In Russian)

In weakly-acid and alkaline solutions (pH = 1 to 12) the adsorption of protactinium on metals (Pt, Au, Fe, Pb, Cu, and Ni) is very weak except at pH = 3 to 4. At pH 3 to 4 the adsorption is different for various metals: Fe > Cu = Ni < Sn ≫ Au > Pt. The maximum Pa adsorption on phosphor-4 and quartz glass was found at pH = 4.5 to 5, and the highest cation charge of complex protactinium was found at 2n HNO_3. (R.V.J.)

16389 SORPTION OF RADIOACTIVE ISOTOPES FROM AQUEOUS SOLUTION BY MANGANESE DIOXIDE. V. V. Pushkarev, E. V. Tkachenko, Yu. V. Egorov, and A. S. Lyubimov. Radiokhimiya, 4: 49-54(1961). (In Russian)

Sorption of Ce^{144}, Y^{91}, Zn^{65}, Ru^{106}, Cs^{134}, Nb^{95}, and Zr^{95} + Nb^{95} from aqueous solutions by active manganese dioxide was studied. An ion exchange mechanism in Ce^{144} and Y^{91} sorption is described. Ru^{106} (pH = 4.0 to 5.0), Nb^{95} and Zr^{95} (pH = 2.0 to 9.0), Zn^{65} (pH = 6.0 to 7.0) are sorbed as radiocolloids while Cs^{134} is not sorbed. (R.V.J.)

16390 ADSORPTION OF Y AND Zr BY ZIRCONIUM PHOSPHATES. V. S. Zlobin. Radiokhimiya, 4: 54-9(1961). (In Russian)

Adsorption of yttrium by zirconium phosphates from hydrochloric solutions (HCl = 0.03n) was analyzed. At pH = 7 the sorption remained constant (about 94%) at 10^{-3} to 10^{-6} M yttrium concentration. At pH = 1 to 7 the sorption was increased. Zr adsorption by zirconium phosphate from hydrochloric acid solution (pH = 1.5) decreased from 98.1 to 91.6% with Zr concentrations 10^{-3} to 10^{-6} M. At pH = 7 the sorption is zero in 10^{-3} to 10^{-6} M solutions. Further reduction of Zr concentration to 10^{-8} M increased the sorption to 18.5%. It is shown that zirconium phosphates are capable of separating radioactive Y and Zr from solutions at pH 1 to 1.5. (R.V.J.)

16391 STRUCTURE OF DIHYDRATE URANYL NITRATE. V. M. Vdovenko, E. V. Stroganov, A. P. Sokolov, and G. Lungy. Radiokhimiya, 4: 59-66(1961). (In Russian)

The structure of dihydrate uranyl nitrate was studied by x-ray diffraction analysis. The dihydrate uranyl nitrate crystal consists of separate $UO_2(NO_3)_2 \cdot 2H_2O$ complexes with linear UO_2^{2+} ions bonded to the water molecules and two NO_3^- group oxygens appearing in distorted trans-position to each other. (R.V.J.)

16392 PLUTONIUM FLUORIDES. E. N. Deichman and I. V. Tananev. Radiokhimiya, 4: 66-73(1961). (In Russian)

Studies of plutonium tetrafluoride solubility in sodium fluoride solutions indicated the formation of two compounds: $NaPuF_5$ and Na_2PuF_6. It was also shown that the two compounds are not readily soluble in sodium fluoride solution. (R.V.J.)

16393 HYDROLYTIC BEHAVIOR OF PLUTONYL IN AQUEOUS SOLUTIONS. A. I. Moskvin and V. P. Zaitseva. Radiokhimiya, 4: 73-81(1961). (In Russian)

Solubility of ammonium diplutonate in aqueous solutions at various pH was studied, and absorption spectra of saturated plutonyl solutions were measured. The experiments indicated a $PuO_2(OH)_2$ solubility product of 1.8 × 10^{-23}. The composition and dissociation constants of products formed; $[PuO_2(OH)]^+$, $[PuO_2(OH)_2]^0$, $[PuO_2(OH)_3]^-$, $[(PuO_2)_2\,(OH)_3]^+$, and $[(PuO_2)_2\,(OH)_5]^-$; were determined. The scheme of plutonyl hydrolysis in aqueous solutions at various pH is included. (R.V.J.)

16394 ELUTION OF Np FROM AM ANIONITE. E. I. Kazantsev, P. I. Kondratov, B. S. Kalinchenko, and A. D. El'man. Radiokhimiya, 4: 81-4(1961). (In Russian)

A fast and complete neptunium elution is achieved by a 5 to 10% solution of ammonium carbonate and 0.1$\underline{n}$ HNO_3 + 2.5 g/l $K_2Cr_2O_7$, while 100 ml of 0.1 to 0.5$\underline{n}$ saline solution and 0.1 to 0.2$\underline{n}$ nitric acid solution elute 92 to 96 and 85 to 92%, respectively. (R.V.J.)

16395 ION EXCHANGE IN STATE STUDIES OF SUBSTANCE STATE IN A SOLUTION. VIII. STUDY OF URANYL CARBONATE SOLUTIONS BY ION EXCHANGE METHOD. V. I. Paramonova and N. M. Nikolaeva. Radiokhimiya, 4: 84-9(1961). (In Russian)

The existence of cationic and anionic U(VI) in carbonate solutions with various additive concentrations and pH was verified by the method of relative absorption. The cation absorption curve reflects U(VI) hydrolysis and does not depend on the carbonate in the solution. The anion absorption curve exhibits carbonate complexing only in a narrow additive concentration region, $CO_3^{2-} \approx 10^{-4}$ to 10^{-7}. The value of the instability constant at ionic strength 0.5 is $K_{2,3} = [UO_2(CO_3)_2^{2-}]\,[CO_3^{2-}]/[UO_2(CO_3)_3^{4-}] = (1.0 \pm 0.1) \times 10^{-7}$. (R.V.J.)

16396 CHROMOTOGRAPHIC SEPARATION OF Pa FROM Zr, Ti, AND Nb. R. A. D'yachkova, V. I. Spitsyn, and P. P. Nazarov. Radiokhimiya, 4: 89-94(1961). (In Russian)

A method of Pa separation from Nb, Ti, and Zr in certain anionites and manganese dioxide is described. It is shown that elution with 0.5 $\underline{n}$ HNO_3 + 0.2 $\underline{n}$ NH_4F completely separates Pa and Nb sorbed on MnO_2. (R.V.J.)

16397 CHROMOTOGRAPHIC CONCENTRATION OF ACTINITE. Fu-chiung Wang, Mei-Hua Kang, and V. A. Khalkin. Radiokhimiya, 4: 94-8(1961). (In Russian)

Chlorine oxidized actinide is adsorbed from concentrated HCl and LiCl solutions by Dowex 50 × 8 (200 to 400 mesh). The distribution coefficients are directly proportional to the HCl concentration up to ≈ 8$\underline{M}$ and LiCl concentration up to ≈ 6$\underline{M}$; $K_{d\,max}^{HCl} = 63 \pm 3$, $K_{d\,max}^{LiCl} = 610 \pm 20$. A method of chromotographic concentration was developed on the basis of preliminary coprecipitation of At and Te followed by separation by filtering 8$\underline{M}$ HCl solution through a cation resin column. The Te passes through while At is adsorbed and later eluted by chlorine. The At in 0.5$\underline{M}$ HCl dries without losses on platinum or silver surfaces at ≈ 90°C. (R.V.J.)

16398 DAMPFDRUCK UND THERMISCHE DISSOZIATION VON NIOBOXYCHLORID (PROMOTIONSARBEIT). (Vapor Pressure and Thermal Dissociation of Niobium Oxychloride (thesis)). Max Gloor (Eidgenössische Technische Hochschule, Zürich). Zurich, Juris-Verlag, 1960. 80p.

The vapor pressure of pure $NbOCl_3$ was measured with its temperature dependence, and can be represented by means of the following relation: $\log p_{mm} = 13.533 - 6433/T$ (473 to 605°K). It was established that the $NbOCl_3$ on heating decomposes to a small degree into pentachloride and a firm solid phase. By consideration of the quantitatively measured decomposition, a relation for the partial pressure of the oxychloride in the equilibrium pressure resulted: $\log p_{mm} = 13.600 - 6478/T$ (473 to 605°K). From this a mean heat of sublimation of the oxychloride in the specified temperature interval was calculated to be 29.6 kcal/mol. A sublimation entropy at the boiling temperature of 604.3°K was calculated as 49.0 cal. Density measurements on superheated vapor of the $NbOCl_3$ showed that this is essentially monomolecular and behaves ideally. By investigation of the optical absorption of the saturated vapor (2500 to 5000A), in combination with a quenching method, the decomposition of $NbOCl_3$ to pentachloride in the temperature interval from 200 to 340°C could be measured quantitatively. The results of the optical absorption measurements on superheated vapor, in agreement with the measurements on saturated vapor, are explained by a decline of decomposition rate of $NbOCl_3$ to at least 500°C. The results of the study indicated two possible reactions: $5(NbOCl_3)g \rightarrow [Nb_2O_5]_s + 3(NbCl_5)g$ and $7(NbOCl_3)g \rightarrow [Nb_3O_7Cl]_s + 4(NbCl_5)g$. (M.C.G.)

16399 PHOSPHATE ALS KOMPLEXBILDNER FÜR STRONTIUM (PROMOTIONSARBEIT). (Phosphate as Complexing Agent for Strontium (thesis)). Hans Gnepf (Eidgenössische Technische Hochschule, Zurich). Zurich, Juris-Verlag, 1961. 62p.

It was sought by means of an ion-exchange method to determine the nature and stability of the complexes of some poly- and metaphosphates with strontium. An investigation was made of the extent and course with time of the adsorption of $Sr^{90}-Y^{90}$ in 2 × 10^{-7} $\underline{M}$ solution of ion strength 0.15 on glass and polyethylene. Y^{90} was quantitatively adsorbed on glass from alkaline solution. In neutral solutions and on polyethylene the adsorption was less. The hydrolysis velocity of different phosphates in the presence of small amounts of strontium was carried out at 20°C at pH 2.6 to 8.9. By means of the ion-exchange method, the strontium complexes of different phosphates were investigated using Sr^{85} and Sr^{89}. Eight complexes were determined in a solution with an ion strength of 0.15 at pH 4 to 9 at 20°C, and their formation constants were calculated. These constants ranged from 0.2 to 8.74. (M.C.G.)

16400 STABLE WAXING DISPERSIONS. Frank Linwood Saunders and James Henry Oswald (to Dow Chemical Co.). British Patent 893,400. Apr. 11, 1962.

A process is given for preparing stable waxing dispersions of a polyethylene wax or a paraffinic wax and vinyl or vinylidene polymers. The process comprises dispersing the wax and a vinyl or vinylidene monomer in a suitable non-polymerizable liquid vehicle, preferably water, and subjecting the dispersion to high-energy ionizing radiation in order to polymerize the vinyl or vinylidene monomer. The resulting wax dispersion is very stable and provides films that are harder and less susceptible to water. A fatty acid and morpholine may be used as dispersants prior to irradiation. (D.L.C.)

16401 FLUORINATED HALOGENATED DIKETONES AND THEIR USE AS CHELATING AGENTS. (to U. S. Atomic Energy Commission). British Patent 895,676. May 2, 1962.

Certain classes of fluorinated β-diketones were discovered which form metal chelates of high solubility in organic solvents. These β-diketones have the formula $R-CO-CH_2-CO-R_1$, where R is a brominated and/or chlorinated alkyl, cycloaliphatic, or aryl radical, and R_1 is a polyfluorinated alkyl or cycloaliphatic radical with 3 to 6 substituent fluorine atoms. These β-diketones may be prepared by the Claisen condensation, and a procedure is given for the synthesis of 1-(3,4-dichlorophenyl)-4,4,4-trifluoro-1,3-butanedione. (D.L.C.)

16402 METHOD FOR THE PREPARATION OF BINARY NITROGEN-FLUORINE COMPOUNDS. Jack W. Frazer (to U. S. Atomic Energy Commission). U. S. Patent 3,033,771. May 8, 1962.

A process is given for preparing binary nitrogen–fluorine compounds, in particular, tetrafluorohydrazine (N_2F_4) and difluorodiazine (N_2F_2). The process comprises subjecting gaseous nitrogen trifluoride to the action of an alternating current electrical glow discharge in the presence of mercury vapors. By the action of the electrical discharge, the nitrogen trifluoride is converted into a gaseous product comprising a mixture of tetrafluorohydrazine, the isomers of difluorodiazine, and other impurities including nitrogen, nitrogen oxides, silicon tetrafluoride, and unreacted nitrogen trifluoride. The gaseous products and impurities are passed into a trap maintained at about −196°C to freeze out the desired products and impurities with the exception of nitrogen gas which passes off from the trap and is discarded. Subsequently, the desired products and remaining impurities are warmed to the gaseous state and passed through a silica gel trap maintained at about −55°C, wherein the desired tetrafluorohydrazine and difluorodiazine products are retained while the remaining gaseous impurities pass therethrough. The desired products are volatilized from the silica gel trap by heating and then separated by gas chromatography means into the respective tetrafluorohydrazine and difluorodiazine products. (AEC)

16403 METHOD OF PREPARING URANIUM PENTAFLUORIDE. W. E. Hobbs (to U. S. Atomic Energy Commission). U. S. Patent 3,035,894. May 22, 1962.

This invention relates to a method for the preparation of UF_5. Gaseous UF_6 and gaseous HBr are contacted under anhydrous conditions and at a UF_6-to-HBr molar ratio of at least approximately 1.7. Beta UF_5 is obtained at a reaction temperature under 125°C, alpha UF_5 at a temperature over 150°C, and a mixture of the alpha and beta forms at intermediate (125 to 150°C) temperatures. (AEC)

16404 PREPARATION OF HIGH-DENSITY, COMPACTIBLE THORIUM OXIDE PARTICLES. K. H. McCorkle, A. T. Kleinsteuber, C. E. Schilling, and O. C. Dean (to U. S. Atomic Energy Commission). U. S. Patent 3,035,895. May 22, 1962.

A method is given for preparing millimeter-size, high-density thorium oxide particles suitable for fabrication into nuclear reactor fuel elements by means of vibratory compaction. A thorium oxide gel containing 3.7 to 7 weight per cent residual volatile nitrate and water is prepared by drying a thorium oxide sol. The gel is then slowly heated to a temperature of about 450°C, and the resulting gel fragments are calcined. The starting sol is prepared by repeated dispersion of oxalate-source thorium oxide in a nitrate system or by dispersion of steam-denitrated thorium oxide in water. (AEC)

Radiation Chemistry and Radiochemistry

Refer also to abstracts 16086, 16091, 16094, 16096, 16097, and 16100.

16405 (NAS-NS-3050) RADIOCHEMISTRY OF URANIUM. PARTS I AND II. James E. Gindler (Argonne National Lab.). [1961]. 355p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

A review of the nuclear and chemical features of uranium is presented. The problems of dissolution of a sample and counting techniques are discussed. A collection of radiochemical procedures for the element as found in the literature is included. (M.C.G.)

16406 (NP-11495) THE EFFECT OF SUBSTITUTION ON THE IONIZATION POTENTIALS OF FREE RADICALS AND MOLECULES. III. ESTIMATION OF THE IONIZATION POTENTIALS OF CYCLOALKYL RADICALS AND CYCLIC AMINES BY δ_K VALUES. IV. δ_K VALUES FOR ALCOHOLS, ETHERS, THIOLS, AND SULFIDES. Technical Report No. 3. Joyce J. Kaufman (RIAS. Div. of Martin Co., Baltimore). Mar. 1962. Contract Nonr 3471(00). 27p.

Discussion and calculations concerning the ionization potentials of cyclopropyl, cyclobutyl, cyclopentyl, and cyclohexyl radicals are presented. Also included are δ_K values, which reflect changes in ionization potential, for alcohols, ethers, thiols, and sulfides. The values are of use in estimating δ_K values of other O-containing molecules, and in differentiating the effects of penetration integrals on C, N, and O cores. (J.R.D.)

16407 (NPCC/MWP(G)/P157) THE REACTION BETWEEN CARBON AND CARBON DIOXIDE UNDER IRRADIATION. Report No. 13,965C. T. B. Copestake and N. S. Corney (General Electric Co., Ltd. Central Research Labs., Wembley, England). Aug. 22, 1961. For United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. Contract 6/ATOMIC/155. 59p.

A description of experimental techniques used in an investigation of radioinduced carbon dioxide–graphite reactions is presented. Results which are well established are presented concerning the dependence of CO formation on radiation dose, CO_2 pressure, and geometrical arrangement of the graphite in the irradiation vessel. Results on radiolysis of CO_2 in the absence of graphite are also included. (J.R.D.)

16408 (NPCC/MWP(G)/P161) THEORETICAL WORK ON THE RADIATION INDUCED REACTION BETWEEN CARBON DIOXIDE AND GRAPHITE. Report No. 13,992C. H. A. Jones (General Electric Co., Ltd. Telecommunications and Engineering Research Labs., Wembley, England). Sept. 1, 1961. For United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England. Contract 6/ATOMIC/155. 20p.

An estimate is made of the rate of CO production when CO_2 is irradiated in the presence of a graphite surface under three geometrical arrangements: (1) CO_2 in a long graphite cylinder, (2) a long graphite rod in a sealed silica tube filled with CO_2, and (3) CO_2 contained between two large parallel planes, one graphite and one inert. It is expected that ultimately the CO concentration would vary with the $^2/_3$ power of time. Curves expressing the variation of CO concentration with time in dimensionless parameters are derived for all three geometrical arrangements. (D.L.C.)

16409 (TID-15424) THE MECHANISMS OF SOME RADIATION INDUCED GAS REACTIONS AND THE CHEMICAL REACTIONS OF ELECTRONS. Annual Report, March 1, 1961–March 30, 1962. Benjamin P. Burtt (Syracuse Univ., N. Y.). Mar. 30, 1962. Contract AT(30-1)-1131. 40p.

Mass spectrometer data were obtained on the ionization efficiency of O^-, NO^-, and N_2O^-. O^- and NO^- are formed by resonant processes at about 2 ev and by other processes at higher energies. N_2O is not formed at low energies, but has an appearance potential of about 16 ev. It was also found that the ion intensity is sensitive to gas pressure. Radiolysis data obtained in experiments with gaseous ammonia indicated that hydrazine, hydrogen, and nitrogen were formed. Preliminary radiolysis experiments were completed on benzene; a small effect was noted upon introduction of an electric field. (J.R.D.)

16410 (AEC-tr-5054) THE EFFECTS OF Co^{60} ON THE RATE OF DECOMPOSITION OF COBALT FORMATE. B. V. Erofeev and V. A. Protashchik. Translated from p.371-6 of "Proceedings of the Symposium on Chemical Effects of Nuclear Transformations. Vol. II" (a publication of the International Atomic Energy Agency, Vienna, 1961. (STI/PUB/34(Vol.II(p.371-6)). 14p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 11773.

16411 (AEC-tr-5055) AN INVESTIGATION OF THE CHEMICAL STATE OF RADIOPHOSPHORUS IN KCl CRYSTALS IRRADIATED WITH HIGH-ENERGY PROTONS. A. N. Murin, S. N. Banasevich, and R. V. Bogdanov. Translated from p.191-9 of "Proceedings of the Symposium on Chemical Effects of Nuclear Transformations. Vol. II" (a publication of the International Atomic Energy Agency, Vienna, 1961. (STI/PUB/34(Vol. II(p.191-9)). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 11756.

16412 PREPARATION OF VOLATILE CARBON-14 LABELED COMPOUNDS FOR COUNTING. Robert H. Hamilton and Donald E. Moreland (North Carolina State Coll., Raleigh). Anal. Chem., 34: 717-18(May 1962).

A technique is described for preparing volatile C^{14}-labeled compounds, which greatly reduced losses from planchets during storage and eliminates contamination of counting chambers and windows. The volatilization of a C^{14}-labeled herbicide, 2-chloro-4-isopropylamino-6-diethylamino-s-triazine (ipazine), and a C^{14}-labeled nematocide, 0,0-diethyl-0-2-pyrazinylphosphorothioate (Zinophos), was reduced from counting planchets. One-in. diameter, sand-blasted, glass planchets were plated initially with 0.25 μg of C^{14}-ring-labeled ipazine in 10 λ of absolute ethanol and with 1.15 μg of C^{14}-ethyl-labeled Zinophos in 10 λ of hexane. Counting was performed with an aluminized-Mylar (1 mg per cm^2), end-window, gas-flow, Geiger-Mueller tube. (P.C.H.)

16413 VULCANIZATION OF ELASTOMERS BY IONIZING RADIATIONS. Alphonse Lamm (Centre d'Études Nucléaires, Saclay, France). Inds. atomiques, 5: No. 11-12, 50-60(1961). (In French)

Works on the reticulation of natural and synthetic rubbers by irradiation, published since 1945, are reviewed. The problems treated by the different investigators are of a theoretical nature (mechanisms of reticulation or degradation and properties of the products obtained as a function of the lattice structure and type of bonding), but they also have a practical aspect (fabrication of tires, process studies, and improvement of the radiochemical yield in order to make radiovulcanization economical). A survey is then made of studies conducted jointly by the Commissariat à l'énergie atomique and the Laboratoire de recherches et de control du caoutchouc. These studies had the purpose of investigating sensitizers in solid rubber, the treatment of rubber in the latex state, and the "reenforcement" of rubber by carbon black by the irradiation of latex and carbon black in aqueous solutions. It appears from these studies that the treatment of elastomers by radiation, especially latex, is an important engineering and economic technique. (tr-auth)

16414 A CHROMATOGRAPHIC METHOD FOR THE STUDY OF THE STABILITY OF LABELED SODIUM POLYMETAPHOSPHATE. L. J. Anghileri (Volk Radiochemical Co., Chicago). Intern. J. Appl. Radiation and Isotopes, 13: 7-10(Jan. 1962). (In English)

An ascending chromatography method developed on the basis of the Ebel technique is used for the differential analysis of phosphates in sodium polymetaphosphate labeled with radiophosphorus. This radiopharmaceutical is therapeutically efficient only with a high ratio of highly condensed molecules. This method gives values close to the photocolorimetric method values. (auth)

16415 APPROXIMATE EMPIRICAL FORMULA FOR SELF-SHIELDING EFFECT IN NEUTRON ACTIVATION. M. Okada (Government Chemical Industrial Research Inst., Tokyo). Intern. J. Appl. Radiation and Isotopes, 13: 53 (Jan. 1962). (In English)

An approximate empirical formula for measuring self-shielding effect in irradiated metals of nearly spherical shape, dissolved before activity measurement, is obtained. An illustrative example is given for indium grains and plots of specific activity are presented for gold, indium, and silver. (N.W.R.)

16416 DIFFUSION KINETICS IN RADIATION CHEMISTRY. II. ONE-RADICAL-ONE-SOLUTE MODEL. CALCULATIONS. Aron Kuppermann and Geneva G. Belford (Univ. of Illinois, Urbana). J. Chem. Phys., 36: 1427-41 (Mar. 15, 1962).

General diffusion-kinetic equations are applied to a one-radical-one-solute model of the radiolysis of dilute aqueous solutions. The validity of the prescribed diffusion approximation is examined. Results of calculations of the effect on the molecular and radical yields of the following parameters are given: solute concentration, solute depletion, shape of initial radical distribution, radical density, diffusion coefficients, and rate constants. Conditions under which a straight track of equal and equidistant spherical spurs can be replaced by either isolated spherical spurs or an axially homogeneous cylindrical track are examined. (auth)

16417 RADIOLYSIS OF METHYLCYCLOHEXANE. I. LIQUID PHASE. G. R. Freeman (Univ. of Alberta, Edmonton, Can.). J. Chem. Phys., 36: 1534-41(Mar. 15, 1962).

The gamma-radiolysis of liquid methylcyclohexane was studied over the dose range 0.40 to 35.0 × 10^{19} ev/ml. The initial 100 ev yields of the products are: H_2, 4.80 ± 0.07; (1-methylcyclohexene + methylenecyclohexane), 2.65 ± 0.15; (3-methylcyclohexene + 4-methylcyclohexene), 0.83 ± 0.10; open chain heptene′, 0.33 ± 0.02; open chain heptene″, 0.31 ± 0.04; bi-methylcyclohexyl, 0.75 ± 0.05; methylcyclohexylheptene, 0.13 ± 0.02. Methylcyclohexyl−methylcyclohexene was a secondary product, resulting mainly from reaction of methylenecyclohexane and partly from reaction of 1-methylcyclohexene. Values of the ratios of the olefin yields to the "dimer" yields in the cyclohexane and methylcyclohexane systems were compared with values of disproportionation to combination ratios for moderately bulky alkyl radicals in the gas phase. It was concluded that the major portions of the olefins and dimers in the radiolytic systems were formed by the disproportionation and combination of radicals. A steric hindrance effect probably has a small influence on the rate of the combination reaction. It was illustrated that a polymerization reaction occurs, involving the olefinic products, although the polymer could not be characterized. The relative significance of the polymerization reaction increases with decreasing dose rate. (auth)

16418 RADIOLYSIS OF METHYLCYCLOHEXANE. II. LIQUID PHASE INHIBITION BY BENZENE. G. R. Freeman (Univ. of Alberta, Edmonton, Can.). J. Chem. Phys., 36: 1542-7(Mar. 15, 1962).

The effect of benzene on the radiolysis of liquid methylcyclohexane (MCH) was studied over the benzene concentration range from 0.25 to 100 mole %. The dominant effect of benzene at low concentrations appears to be one of hydrogen atom scavenging. At higher concentrations, the transfer of energy (excitation or ionization) from activated MCH to benzene also becomes important. As in the liquid cyclohexane system, there seem to be two major reactive species in γ irradiated MCH. One species, C_7H_{14}', decomposes to produce cold hydrogen atoms that can be scavenged by benzene. The other species, C_7H_{14}'' or $C_7H_{14}^+$, produces hydrogen by a mechanism that is not subject to atom scavenging but which can be inhibited by an energy transfer process. The 100-ev yields of the activated species in pure MCH are $G(C_7H_{14}') = 1.8 \pm 0.3$ and $G(C_7H_{14}'') = 3.0 \mp 0.3$. These compare with the cyclohexane yields $G(C_6H_{12}') = 2.4 \pm 0.3$ and $G(C_6H_{12}'') = 3.0 \mp 0.3$. Reaction mechanisms were proposed and tested against the experimental data. (auth)

16419 STUDY OF THE RADIOLYSIS OF METHANE IN THE GASEOUS PHASE. Jean Maurin (Compagnie Française de Raffinage, Centre de Recherches, Gonfreville l'Orcher, France). J. chim. phys., 59: 15-26(Jan. 1962). (In French)

The radiolysis of methane was effected by varying some little studied parameters: temperature, pressure, and intensity. In all cases, the principal products formed are hydrogen, ethane, and a heavy liquid. The effect of the intensity is practically zero. That of the temperature depends on the dose received by the methane. High pressures of the order of 300 atm causes a decrease in the radiolysis yield. These results are studied in the discussion. Experiments made in the presence of xenon favor the hypothesis of a radical mechanism for the radiolysis of methane rather than an ion-molecule mechanism. (tr-auth)

16420 RADIOLYSIS OF AQUEOUS SOLUTIONS OF PLUTONIUM. Monique Pagès (Université, Paris). J. chim. phys., 59: 63-77(Jan. 1962). (In French)

The effect of gamma rays on aqueous solutions of plutonium in various valence states was studied in sulfuric, perchloric, nitric, and hydrochloric media. The principal phenomenon is the reduction of Pu^{6+} to Pu^{5+} followed by the dismutation of the (V) valence state into the (VI) and (IV) states. For sulfuric and perchloric solutions (0.2 $\underline{N}$), the reaction mechanism was given. The radiolysis of the water leads to OH, H_2O_2, H, and H_2 products. Pu^{6+} is reduced by H and H_2O_2 whereas Pu^{5+} is reoxidized by OH. However the action of the hydrogen peroxide is slow and provokes a prolonged effect. Measurements of Pu^{6+} disappearance and Pu^{4+} appearance made by spectrophotometry led to the values $G_{H_2O_2} = 0.8$ and $G_H - G_{OH} = 0.8$. $G_{H_2} = 0.41$ was determined by gas microanalysis. These values permit the calculation of the radiolysis yield of water as $G_{H_2O} = 4.35$. Cl^- and particularly NO_3^- inhibit the reduction and can suppress it completely. The effect of α particles of Pu and Po is very analogous to that of hydrogen peroxide. The reduction takes place after longer or shorter induction periods according to the anion (principally HSO_4^-). The lengths of the induction period are connected to the accumulation of H_2O_2 and/or plutonium peroxide. At weak acidities, the peroxide of Pu^{4+} has a tendency to lead to polymerized forms. In the most simple cases (0.2 $\underline{N}$ H_2SO_4 and $HClO_4$) the following yields were obtained or calculated: $G_{eq,\, red} = 3.2$, $G_{H_2O_2} = 1.35$, G_{H_2} 1.6, and $G_H - G_{OH} = 0.1$, by supposing that $G_{HO_2} = 0.2$. The hypotheses usually used for the radiolysis of water by α particles were taken. (tr-auth)

16421 ABSOLUTE COUNTING OF ^{103}Ru. G. G. George, A. O. Thomas, and D. E. Watt (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Inorg. & Nuclear Chem., 23: 1-5(Dec. 1961). (In English)

The absolute measurement of Ru^{103} activities is complicated by adsorption in the source of the soft electrons associated with the decay. It is shown that Ru^{103} in an equilibrium source of $Ru^{103}-Rh^{103m}$ can be measured to be better than ±2% by sandwiching normal 4π sources between known thicknesses of aluminum absorber and counting in a 4πβ-γ coincidence counter. The method can be used for resolving the components of mixtures of Ru^{103} and Ru^{106} in fission products. (auth)

16422 THE SZILARD-CHALMERS REACTION IN BROMOETHANE. B. Knight, G. E. Miller, and P. F. D. Shaw (Clarendon Lab., Oxford). J. Inorg. & Nuclear Chem., 23: 15-24(Dec. 1961). (In English)

Analyses of the radioactive products resulting from the capture of thermal neutrons in bromoethane–bromine mixtures were made by using gas chromatographic techniques. Most of the high energy products can be accounted for by reactions involving the radio-bromine atom and a single molecule of bromoethane to form a dibromoethane molecule or a dibromoethyl radical. The reactions of the latter indicate that there is a close correlation between the organic radicals and inorganic species present in the thermal zone. This is inconsistent with the initial formation of a large number of radicals. (auth)

16423 LOW-TEMPERATURE INVESTIGATION OF THE SZILARD-CHALMERS REACTION IN POTASSIUM PERMANGANATE. S. R. Veljković and G. Harbottle (Brookhaven National Lab., Upton, N. Y.). J. Inorg. & Nuclear Chem., 23: 159-60(Dec. 1961). (In English). (BNL-5641)

Recrystallized, irradiated potassium permanganate was dissolved in acetone which was specially purified to remove methanol, and the reduced form of manganese-56 was collected. The maximum chance of reformation (or non-disruption) of a permanganate ion through the nuclear process was found to be less than 5% and at least three-quarters of the retention observed at room temperature was the result of annealing processes, which occurred at appreciable rates even in the temperature range –60 to –90°C. The results show that, to obtain retention figures which reflect the primary effect of recoil undistorted by annealing, temperatures must be limited to extremely low values during every stage of the experiment, prior to the actual moment of dissolution. (P.C.H.)

16424 ETHYLENE AS A SCAVENGER IN THE RADIOLYSIS OF LIQUID CYCLOPENTANE. Richard A. Holroyd (Mellon Inst., Pittsburgh). J. Phys. Chem., 66: 730-3 (Apr. 1962).

Ethylene, when present as a scavenger during the radiolysis of liquid cyclopentane, leads to two additional products, ethane and ethylcyclopentane. Ethyl radicals are formed by addition of hydrogen atoms to ethylene. Cyclopentyl radicals either add to ethylene or combine with radicals depending on the dose rate. The activation energy for addition of cyclopentyl radicals to ethylene is $6.7 + \frac{1}{2}E_4$, where E_4 is the energy of activation for recombination of cyclopentyl radicals in solution. At relatively low dose rates, the rate of formation of ethylcyclopentane is proportional to the ethylene concentration times the square root of the dose rate. It is estimated that the rate of disproportionation of ethyl and cyclopentyl radicals relative to recombination in the liquid phase is 1.7. Radicals addition to unsaturates becomes an important secondary reaction at low dose rates in the radiolysis of saturated hydrocarbons if reaction is carried to relatively high conversions. (auth)

16425 EFFECT OF INTENSITY ON THE RADIATION INDUCED DECOMPOSITION OF INORGANIC NITRATES. Everett R. Johnson (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 66: 755-8(Apr. 1962).

The effect of intensity on the decomposition of inorganic nitrates, KNO_3, $NaNO_3$, $CsNO_3$, and $Pb(NO_3)_2$, by gamma radiation and electron beams was studied. Dose rates varied from 10^{15} to 10^{20} ev/g/sec. It was concluded that within experimental error there was no appreciable intensity effect, considering the range of intensities used. There was definitely no evidence for the reaction $O + O \rightarrow O_2$. (P.C.H.)

16426 THE MECHANISM OF THE "UNIMOLECULAR" YIELD OF HYDROGEN IN THE RADIOLYSIS OF LIQUID CYCLOHEXANE. P. J. Dyne (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Phys. Chem., 66: 767(Apr. 1962).

The unimolecular hydrogen yield mechanism in the radiolysis of liquid cyclohexane was detected by measuring the yield of D_2 produced in the radiolysis of c-C_6H_{12}–c-C_6D_{12} mixtures, which are first order with respect to the C_6D_{12} concentration. It is argued that the interaction must be by a quenching or energy-transfer type type process. The data, interpreted in terms of a diffusion-controlled reaction, show that the collision efficiency for the radical scavenger reaction for both benzene and iodine would have to be close to unity. It is concluded that justification is given for assuming that benzene and iodine reduce the unimolecular yield by a quenching or energy-transfer mechanism, rejecting a scavenging interaction, and part, if not all, of the unimolecular yield probably occurs by a true molecular splitting. (P.C.H.)

16427 PRODUCTION OF UNIFORM MATERIAL LAYERS FOR THE MEASUREMENT OF RADIOACTIVITY OF YTTRIUM-90-OXALATE DEPOSITS WITH THE AID OF CENTRIFUGAL FORCE. G. Kistner (Bundesforschungsanstalt für Lebensmittelfrischhaltung, Karlsruhe, Ger.). Kerntechnik, 4: 124(Mar. 1962). (In German)

The determination of the specific activity of a radioactive precipitate with the help of a bell counting tube or a proportional counter demands the preparation of very uniform layers on the measuring dish. For determining the Sr^{90} content of food, which is measured by the yttrium oxalate precipitate, a small detachable centrifuge tube was tried for the production of uniform layers. A measuring plate of aluminum or steel was fastened, by means of a screw cap, to a plexiglas tube to serve as its bottom. The precipitate was placed in the tube and centrifuged at 3000 rpm. A layer of uniform thickness was produced on the measuring plate. (M.C.G.)

16428 THE EFFECT OF IRRADIATION ON THE DIELECTRIC PROPERTIES OF POLYVINYL CHLORIDE. D. Kiessling (Institut für Plastforschung–Bereich Physik, Deutsche Akademie der Wissenschaften, Berlin and Universität, Leipzig). Kolloid-Z., 176: 119-28(June 1961). (In German)

The most important change which appears in the polyvinyl chloride (PVC) molecules following irradiation is the HCl-cleavage. It is combined with the originating macromolecular radical and unsaturated bonds. This reaction starts a series of further chemical reactions for which the presence or absence of oxygen in the reaction zone is of decisive importance. It was established that in the presence of oxygen, decomposition reactions are predominant, and in the absence of oxygen, cross-linking reactions are predominant. The radiochemical processes resemble those caused by irradiation with ultraviolet light or by thermal treatment. Plasticized PVC likewise shows cross-linking after irradiation. The characteristic HCl-cleavage did not appear. Identification of the structural change is difficult. The structural change of the PVC molecule influences the intermolecular binding ratios of the macromolecules as well as the size of the effective partial dipole moment of the molecule segments. These changes express themselves in the electrical behavior in an extension of the observed dispersion zones at lower temperatures. The size of the damage factor maximum and the height of the dielectric constant jump experienced a decline. Elevated temperatures during irradiation caused a strengthening of the radiochemical effect. After irradiation of compact material in air or protective gas, no essential distinction could be made in the dielectric behavior. In plasticized PVC the radiation effects included an extension of the dispersion region to higher temperatures and an increase in the dielectric constant. (tr-auth)

16429 THE ELECTRON SPIN RESONANCE SPECTRUM OF $CH_3\dot{C}H(CO_2H)$ BETWEEN 100°K AND 200°K. A Horsfield, J. R. Morton, and D. H. Whiffen (National Physical Lab., Teddington, Middx., Eng.). Mol. Phys., 5: 115-20(Mar. 1962).

The electron spin resonance spectra of $CH_3\dot{C}H(CO_2H)$ in γ-irradiated α-alanine between 100 and 200°K differ from the spectra obtained above and below this range. The "intermediate temperature" spectra are interpreted in terms of a critical rate of rotation of the methyl group. From the line-width change near 100 and 200°K an estimate of approximately 4 kcal was made for the activation energy hindering the rotation of the methyl group. (auth)

16430 ELECTRONIC ABSORPTION SPECTRA OF CO_2^- TRAPPED IN γ-IRRADIATED CRYSTALLINE SODIUM FORMATE. G. W. Chantry and D. H. Whiffen (National Physical Lab., Teddington, Middx., Eng.). Mol. Phys., 5: 189-94(Mar. 1962).

The first three absorption bands of CO_2^- trapped in crystalline sodium formate were detected, and their intensities and directions of polarization were determined. The spectrum is similar to that calculated for NO_2 apart from a large shift to higher energies. The first absorption band of HCO_2^- is shown to be polarized parallel to the O...O direction in this ion. (auth)

16431 POLYMER PRODUCTION IN THE RADIOLYSIS OF LIQUID CYCLOHEXANE. R. Barker and M. R. H. Hill (Atomic Energy Research Establishment, Wantage Research Labs., Berks, Eng.). Nature, 194: 277-8(Apr. 21, 1962).

Liquid cyclohexane was irradiated with Co^{60} gamma radiation at a dose rate of 1.2×10^{17} ev/min-g and then analyzed for cyclohexene, bicyclohexyl, and polymers containing 3 or more cyclohexane units. The G for cyclohexene and bicyclohexyl decreased with dose, while the G(polymer) increased. The polymers in turn were analyzed and found to contain hydrocarbons up to C_{30}. A reaction scheme is proposed to explain the results. Irradiation with a pulsed x-ray beam of instantaneous dose rate = 4.2×10^{20} ev/min-g gave constant G for cyclohexene and bicyclohexyl and no polymer formation. (D.L.C.)

16432 EFFECT OF γ-RAYS ON THYMINE IN DE-AERATED AQUEOUS SOLUTIONS. B. Ekert (Institut du Radium-Fondation Curie, Paris). Nature, 194: 278-9 (Apr. 21, 1962).

Column and paper chromatography was used to identify products formed in irradiated solutions of thymine in the absence of oxygen. The products identified were hydroxymethyluracil (G 0.1) cis and trans thymine glycol, and dihydrothymine. (D.L.C.)

16433 THIN FILMS OF SEPARATED ISOTOPES BY CATHODIC SPUTTERING. L. B. Warner (Florida State Univ., Tallahassee). Nuclear Instr. & Methods, 14: 315-17 (Jan. 1962). (In English)

The construction and use of a chamber for the production of thin films from milligram quantities of separated isotopes by cathodic sputtering are described. It is adapted for the coating of thin substrates supported on frames suitable for use as accelerator targets or beta spectroscopy sources. Typical operating conditions yield films of various metals, up to opacity in thickness, in one to twelve hours. Details are included for the sputtering of osmium. (auth)

16434 ABSOLUTE YIELD MEASUREMENTS ON RADIATION-PRODUCED RADICALS BY ELECTRON SPIN RESONANCE. W. Koehnlein and A. Mueller (Kernforschungszentrum, Karlsruhe, Ger.). Phys. in Med. Biol., 6: 599-604(Apr. 1962).

The method of measuring the concentration of paramagnetic centers is considered systematically. Some new points of view, and some instrumental accessories are discussed in detail, especially a double sample cavity for comparisons at different temperatures which employs 100 kc modulation, and also a first moment balance which allows the determination of relative concentrations in a very simple way. The yields of radicals produced by x radiation in amino acid compounds were re-measured and the results compared with those of other authors. The values are between 20 and 80 ev per radical, except for aromatic amino acids which need higher energies. (auth)

16435 RADICALS IN IRRADIATED FORMATES AND OXALATES. J. A. Brivati, N. Keen, M. C. R. Symons, and P. A. Trevalian (The University, Leicester, Eng.). Proc. Chem. Soc., 66-7(Feb. 1961).

Potassium and sodium formates and oxalates were exposed to gamma rays from a Cs^{137} source, in an attempt to form and trap the radical ion Co_2^-. Some remarkable results were found for the formates. From the powders, four lines of equal spacing and intensity, but with broadening on the high-field side were obtained. Single crystals of sodium formate gave spectra comprising four well resolved, symmetrical lines with a splitting between any pair ranging from 7.3 to 9.5 gauss in the manner expected for axially symmetrical radicals. The results are compatible with the concept that CO_2^- radicals are formed in such a way that weak bonding occurs between the central carbon and one specific alkali metal cation. Spectra of irradiated oxalates were similar to the corresponding formates except that in no instance was a quartet of lines such as those from sodium and potassium formate observed. (P.C.H.)

16436 FREE-RADICAL ARYLATION AND AROYLATION OF AROMATIC COMPOUNDS INDUCED BY GAMMA-RADIATION. A. F. Everard and G. A. Swan (King's Coll., Newcastle-upon-Tyne, Eng.). Proc. Chem. Soc., 212-13 (June 1961).

Gamma irradiation of bromobenzene was found to give rise to a complex mixture of products, including three isomeric bormobiphenyls. The ratio of the isomers was determined by the isotope dilution method. Aliquot parts of irradiated bromo-C^{14}-benzene were treated with known weights of the respective bromobiphenyl, which was then isolated. 4-Bromobiphenyl was isolated as such, but the 2- and 3-isomers were obtained as crystalline dinitroderivatives. The isomer ratio was found to be consistent with the assumption of an initial free radical attack of phenyl radicals on bromobenzene. The formation of benzophenone by gamma irradiation of a mixture of benzene and benzoyl chloride was also shown. (P.C.H.)

16437 THE IRRADIATION OF UNSATURATED SULTONES. E. Henmo, P. de Mayo, A. B. M. Abdus Sattar, and A. Stoessl (Univ. of Western Ontario, London, Can.). Proc. Chem. Soc., 238-9(July 1961).

Radiolysis yields of unsaturated sultones are reported. In all cases discussed, the ring was carboxylic or contained one oxygen atom (R and R′ = alkyl or acetyl, X = O; or CRR′ = CO, X = O). (P.C.H.)

16438 ELECTRON-SPIN RESONANCE SPECTRA OF ALKYL RADICALS IN γ-IRRADIATED ALKYL HALIDES. P. B. Ayscough and C. Thomson (The University, Leeds, Eng.). Proc. Chem. Soc., 247-8(July 1961).

It was shown, by examination of electron spin resonance spectra of gamma irradiated samples of alkyl halides, that parent alkyl radicals are the main species trapped at −196°. Apart from differences in line width, the hyperfine spectra observed after irradiation depend on the number and relative orientation of the α and β protons of the alkyl fragment only and are independent of the nature of the attached group R and of the halogen atom in the starting material. It is estimated that the β protons in the radicals observed are in a relatively fixed orientation displaced about 15° from one or the other of the two symmetric positions with respect to the p-orbital of the unpaired electron. (P.C.H.)

16439 RADIATION-INDUCED OXIDATION OF PROTEIN IN AQUEOUS SOLUTION. Warren M. Garrison, Michael E. Jayko, and Winifred Bennett (Univ. of California, Berkeley). Radiation Research, 16: 483-502(Apr. 1962). (UCRL-9813; UCRL-9897(p.66-83))

The action of ionizing radiations on compounds containing primary amine, secondary amine, N-alkylamide, and peptide bond configurations are correlated in terms of related mechanisms involving the N−C linkage as the locus of chemical change. It is shown that major radiation-chemical changes in aqueous protein systems may be interpreted in terms of a general over-all reaction: $R_2N-CHR_2 + O_2 + H_2O \rightarrow R_2NH + RCOR + H_2O_2$, where R_2N-CHR_2 may represent any of the variously substituted N − C linkages of protein molecular structure. Detailed experimental studies of oxidation products derived from various such loci are reported, correlations with studies of dry protein are given. (auth)

16440 PHYSICO-CHEMICAL PROPERTIES OF RADIOACTIVE SUBSTANCE SORPTION DYNAMICS. S. Z. Roginskii and O. M. Todes. Radiokhimiya, 4: 39-44(1961). (In Russian)

Equations are developed for radioisotope sorption for the case where the decay products are not adsorbed. The adsorption of β emitting chloride is analyzed. (R.V.J.)

16441 SEPARATION OF CARRIER-FREE FISSION FRAGMENTS FROM U AND Th. R. V. Sedletskii and K. A. Petrzhak. Radiokhimiya, 4: 99-102(1961). (In Russian)

A rapid, high-yield method for the carrier-free separation of fission fragments from irradiated uranium is described. A method was also developed for separating carrier-free rare-earth fragments from irradiated thorium with a yield of 50 to 60%. (R.V.J.)

16442 REACTION OF TRITIUM RECOIL WITH BENZENE. A. N. Nesmeyanov, B. G. Dzantiev, V. V. Pozdeev, and E. F. Simonov. Radiokhimiya, 4: 116-22(1961). (In Russian)

Considerable amounts of hydration products (cyclohexadienes and cyclohexane) were formed, in addition to active benzene and its disintegration products, in tritium recoil-liquid benzene reactions. The isotopic effect in recoil tritium reactions in ordinary and deuterated benzene is 1.14. The yield of labeled products in a homogeneous benzene–lithium ethylate is higher than in a heterogeneous benzene–lithium carbonate mixture. (R.V.J.)

16443 LABELING PHARMACEUTICAL COMPOUNDS BY NEUTRON BOMBARDMENT. Richard E. Ogborn, Arthur L. Dunn, Cleamond D. Eskelson, Gordon F. Johnson, and Lawrence R. James (Veterans Administration Hospital, Omaha). Radiology, 78: 619-24(Apr. 1962).

Results are reported from preliminary investigations of the preparation of labeled pharmaceutical compounds by neutron bombardment. Instrumentation and techniques are described. Results are summarized on the preparation of a multitude of compounds by recoil labeling by many investigators. Advantages and disadvantages of the use of these compounds in medical studies are discussed briefly. (C.H.)

16444 IMPROVEMENTS IN OR RELATING TO ORGANOSILOXANE COMPOSITIONS. (to Dow Corning Corp.). British Patent 893,399. Apr. 11, 1962.

A process is outlined for preparing a silicone rubber stock with improved resistance to radiation at high temperatures, e.g., 200 Mrad at 200°C. The stock consists essentially of a mixture of (1) 100 parts by weight of an organopolysiloxane having 1.9 to 2.01 organic radicals/Si atom, the radicals being methyl, phenyl, vinyl, or 3,3,3-trifluoropropyl radicals, at least 25% of the radicals being methyl, and the siloxane having a viscosity of ≥ 500 cs. at 25°C and (2) 1 to 10 parts by weight of indanthrene blue, phthalocyanine, a chelated metal-phthalocyanine complex, or terphenyl. The stock may be vulcanized and may contain an inorganic filler. (D.L.C.)

16445 IMPROVEMENTS RELATING TO POLYCHLOROPRENE ELASTOMERS. (to E. I. Du Pont de Nemours & Co.). British Patent 893,851. Apr. 11, 1962.

A method is given for preparing an easily processable polychloroprene elastomer composition without an "elastic memory" to interfere with forming processes carried out with rubber-forming machinery. The method comprises preparing an intimate blend of a plastic, benzene-soluble polychloroprene and a cross-linked, benzene-insoluble polychloroprene obtained by irradiating polychloroprene latex with $\geq 3 \times 10^6$ rad of 0.5- to 5.0-Mev beta radiation. The ratio of irradiated to unirradiated polychloroprene in the blend should be between 1 : 4 and 4 : 1, and a third component may be added in the form of a fluid chloroprene in amounts up to 20 wt % of the blend. (D.L.C.)

16446 PROCESS FOR MODIFYING POLYMERS AND PRODUCTS OBTAINED THEREBY. Roger Arnold Hines and Warren Froemming Busse (to E. I. Du Pont de Nemours Co.). British Patent 893,989. Apr. 18, 1962.

A process for crosslinking crosslinkable polymers by means of irradiation is given which increases the efficiency of the radiation. The process comprises mixing the polymer with 0.25 to 15 wt % of a finely divided polymeric perfluoroolefin resin and subjecting the mixture to high-energy radiation. Seven examples of the process are given in which polyethylene is crosslinked. (D.L.C.)

16447 IMPROVEMENTS IN OR RELATING TO THE MANUFACTURE OF ISOTOPES. Pierre Paul Mommen, Emile Van Oevelen, and Louis Nieuwenhuys. British Patent 894,288. Apr. 18, 1962.

A process is given for the manufacture of isotopes without using neutrons. The process comprises subjecting the target substance simultaneously to a stream of gamma rays and to a magnetic field. The process is applicable to the light elements of the first period of the periodic table as well as to the metals or gases of the Groups II, IV, V, VI, and VIII of the table and their compounds. An example of the process is given in which natural Be metal is treated to yield long-lived radioisotopes. (D.L.C.)

16448 IMPROVEMENTS RELATING TO GRAFT COPOLYMERS OF CONDENSATION POLYMERS. (to E. I. Du Pont de Nemours & Co.). British Patent 894,395. Apr. 18, 1962.

A method is given for modifying a shaped structure, e.g., fibers, of a synthetic oxygen-linked condensation polymer to have increased dyeability and reduced tendency to retain static charges while still retaining its desirable properties, e.g., wear resistance, resilience, etc. The method comprises producing free radicals on the polymers by means of high-energy ionizing radiation, while in contact with a vinyl amide compound, to form graft copolymers thereon. Several examples of the method are given in which acrylamide or poly(vinyl pyrrolidone) is grafted onto fabrics of polyethylene terephthalate and the dyeability of the resulting fabrics determined. (D.L.C.)

16449 PROCESS FOR MAKING GRAFT COPOLYMERS. John Dennis Griffin and Adolphe Chapiro (to Centre National de la Recherche Scientifique and Dow Chemical Co.). British Patent 894,753. Apr. 26, 1962.

A process is outlined for making graft copolymers from polyethylene. The process comprises the steps of subjecting polyethylene in vacuum to high-energy ionizing radiation for a dose of 0.04 tp 20 Mrep to form active centers thereon, converting the centers into oxygenated sites by contacting the irradiated polyethylene with oxygen within 5 min after irradiation, and contacting the oxygenated polymer with a monomer. The polyethylene preferably has a molecular weight of 15,000 to 60,000, and the monomer can be any vinyl or vinylidene compound capable of polymerization by peroxygen compounds or free radicals to form an addition polymer. (D.L.C.)

16450 IMPROVED PROCESS OF POLYMERIZATION OF ALIPHATIC OR ARYL-ALIPHATIC DIOLEFINES WITH CONJUGATED LINKAGES. (to Compagnie Francaise de Raffinage). British Patent 894,756. Apr. 26, 1962.

A method is given for radioinduced polymerization of aliphatic or aryl aliphatic diolefins with conjugate linkages to solids of high molecular weight. The method comprises subjecting the diolefin to ionizing radiation at a temperature less than −40°C, so that the speed of polymerization is proportional to the first power of the radiation intensity. The method preferably is carried out in a chlorinated solvent of polar character, e.g., methylene chloride and dichloroethane. Examples of the method are given in which isoprene and butadiene are polymerized. (D.L.C.)

16451 UNSATURATED SULFIDES. Rector P. Lonthan (to Phillips Petroleum Co.). U. S. Patent 3,031,391. Apr. 24, 1962.

A method is given for the production of unsaturated sulfides at rapid rates with good yields. The method comprises irradiating a mercaptan and/or hydrogen sulfide in the presence of a halogenated unsaturated compound at 35 to 250°C. The role of the radiation apparently is to bring about dehydrohalogenation of the resulting reaction complex. Examples of the method are given in which 2-methyl-2-propenyl n-octyl sulfide is synthesized. (D.L.C.)

Raw Materials and Feed Materials

16452 (CEA-2103) PREPARATION A L'ETAT SOLIDE DE MONONITRURE D'URANIUM MASSIF A PARTIR DE POUDRES D'URANIUM ET DE NITRURES SUPERIEURS D'URANIUM. (Solid State Processing of Massive Uranium Mononitride, Using Uranium and Uranium Higher Nitride Powders as Starting Materials). Jacques Molinari (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 56p.

Thesis submitted to Université, Paris.

The mechanism and the optimum conditions for preparing UN were studied. The results were used for hot pressing (250 kg/cm^2, 1000°C, under vacuum) a mixture of powders of U and higher U nitrides. The products obtained were identified by x-ray measurements and may be either UN, or α U–UN depending on conditions. As revealed by the curved shape of grain boundaries, the sinters obtained do not easily evolve toward physico-chemical equilibrium when submitted to heat treatment. This behavior is quite different from the one observed with UN prepared by a similar method. This fact may be ascribed to the insolubility in the matrix UN of particles of UO$_2$ being present as impurities. The density, hardness, and thermal conductivity of these products are higher than those measured on UN or U–UN cermets obtained by other methods. (auth)

16453 IMPROVEMENTS IN OR RELATING TO THE EXTRACTION OF URANIUM. (to General Mills, Inc.). British Patent 894,807. Apr. 26, 1962.

The usual process for extraction of U from ores by acid leaching, amine extraction, and aqueous stripping is modified to prevent precipitation of a Mo-amine complex at the interface. The modification comprises treating the organic phase with a reducing agent to lower the valence state of Mo therein. The reducing agent is either a sulfide or a thiosulfate. (D.L.C.)

16454 CATALYZED OXIDATION OF URANIUM IN CARBONATE SOLUTIONS. Warren E. Clifford (to U. S. Atomic Energy Commission). U. S. Patent 3,036,881. May 29, 1962.

A process is given wherein carbonate solutions are employed to leach uranium from ores and the like containing lower valent uranium species by utilizing catalytic amounts of copper in the presence of ammonia therein and simultaneously supplying an oxidizing agent thereto. The catalysis accelerates rate of dissolution and increases recovery of uranium from the ore. (AEC)

Separation Processes

16455 (CEA-2111) PURIFICATION DU KRYPTON. (Krypton Purification). Y. Larher (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 5p.

The amount of xenon in otherwise very pure krypton can be reduced from 1.5 to 0.0025 per cent approximately by passage through an activated carbon column at dry-ice temperature. The circulation of the krypton is effected by condensing at –196°C and then evaporating. (auth)

16456 (EURAEC-207) REPROCESSING OF IRRADIATED URANIUM. Quarterly Report No. 2, July through September 1961. (Brussels. Centre d'Étude de l'Énergie Nucléaire). Nov. 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract 049-61-4RDB. 58p.

Reduction and chlorination reactions of irradiated UO$_2$ were studied thermogravimetrically for improvement of chlorination retreatment. Data on reduction of U$_3$O$_8$ in the presence of alumina and on the transformation of UO$_2$ and UC to UF$_4$ were obtained for operational guidance. The high-temperature UC–UF$_4$ reaction eliminates most of the fission I. Good results are reported in subjecting sintered UO$_2$ to complete retreatment cycles. A study of the characteristics of a UF$_6$ distillation column is in progress. (J.R.D.)

16457 (ORNL-3227) COMPARATIVE COST STUDY OF PROCESSING STAINLESS STEEL-JACKETED UO$_2$ FUEL: MECHANICAL SHEAR-LEACH VS SULFEX-CORE DISSOLUTION. J. B. Adams, A. M. Benis, and C. D. Watson (Oak Ridge National Lab., Tenn.). Apr. 23, 1962. Contract W-7405-Eng-26. 58p.

The economics of mechanical shear-leach and Sulfex decladding-core dissolution head end treatments for processing typical tubular bundles of stainless steel-jacketed UO$_2$ nuclear fuels were compared. A 2.66 metric ton U/day head end portion of a plant was designed for each process and capital and operating costs were developed. For plants of this size and larger, mechanical shear-leach processing has the advantage of ~20% lower capital cost and 50% lower operating cost. Processing costs of stainless steel-jacketed UO$_2$ by the Sulfex and shear-leach methods, including amortization and waste disposal but excluding solvent extraction, were \$15.78 and \$2.71/kg U, respectively. Storage of stainless steel waste produced by the shear-leach method is less costly by a factor of 20 than for Sulfex. (auth)

16458 PRINCIPLES OF CENTRIFUGAL SEPARATION. SOME FUNDAMENTAL PROBLEMS IN CENTRIFUGE DESIGN. O. Kjellgren (AB Separator, Stockholm). Chim. e ind. (Milan), 43: 1128-34(Oct. 1961). (In Italian)

After a short review of the principles controlling the processes of sedimentation and centrifugal separation, the main design features of a centrifugal separator are discussed. Directing criteria are: feed composition, chemical process in which the apparatus shall be used, and desired results. (auth)

16459 SEPARATION OF URANIUM FROM FISSION PRODUCTS USING ALUMINA. N. Oi (Tokyo Shibaura Electric Co., Kawasaki, Japan). J. Inorg. & Nuclear Chem., 23: 123-31(Dec. 1961). (In English)

Adsorption of fission products by alumina from irradiated uranyl nitrate in non-aqueous media such as ether, ester, or ketone was investigated. Uranyl nitrate containing fission products was dissolved in an organic solvent, in which water is slightly soluble, and this solution was passed through a column of alumina. Nearly all the fission products were retained on the column while the uranium passed through almost unadsorbed. Of the fission products, ruthenium and cesium were less strongly adsorbed and caused the contamination of the uranyl solution. Yet, the elution of cesium could be reduced by adding acid clay to the alumina. The K$_d$ values of fission products for alumina were found to decrease with the increase of uranyl concentration in the solvent. Free nitric acid should be eliminated because it greatly reduces the adsorption of ruthenium and zirconium. The adsorption of fission products was not influenced by the uranium which was also adsorbed. (auth)

16460 PROCESS OF A PREPARATION OF ACTINIUM-CONTENT FROM "URANLAUGRÜCKSTÄNDE". Csaba Ujhelyi. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 3: 117-22(1961). (In Hungarian)

An operative process for Ac preparation from uranium back residue is described. Preparations consisted mainly of the hydroxides of rare earths and manganese dioxide hydrate. The activity of the preparations was checked and some characteristic points are reported. It was found that decay measurements obtained directly from the preparations were not reliable. (auth)

16461 TEMPERATURE DEPENDENCE OF DISTRIBUTION COEFFICIENTS IN URANYL NITRATE EXTRACTION FROM AQUEOUS SOLUTION BY DIETHYL ETHER. R. T. Golovatenko and O. Ya. Samoilov. Radiokhimiya, 4: 25-34(1961). (In Russian)

Distribution coefficients in uranyl nitrate extraction from aqueous solutions by diethyl ether in the presence of Li, Na, K, Cs, Mg, Ca, Co, Ni, Zn, Sr, Cd, and HNO_3 were measured at various concentrations and at 0, 5, 10, 15, 20, and 25°C. At constant concentration the salting-out efficiency increases with decreasing cation radius (Sr^{2+}, Ca^{2+}, Mg^{2+}, Cs^+, K^+, Na^+, and Li^+). The ln α dependence on (1/RT) in the presence of salting-out is linear except at NO_3^- concentration of 4.37 g eq per liter of solution. The $[d \ln \alpha/d(1/RT)]$ (describing ΔE_{max}) magnitudes are determined. (R.V.J.)

16462 SALTING OUT EFFECTS OF METAL NITRATES OF THE SECOND PERIODIC GROUP IN URANYL NITRATE EXTRACTION BY DIETHYL ETHER. V. M. Vdovenko, T. V. Kovaleva, and V. G. Potapov. Radiokhimiya, 4: 34-9(1961). (In Russian)

Distribution coefficients of uranyl nitrate between diethyl ether and aqueous solution containing metal nitrates as salting-out agents are determined. At equal salting-out mole fractions in aqueous solution, the salting-out effect of nitrates increases directly with cation charge and inversely with radius. The salting-out effect of the zinc subgroup is higher than that of the main group. (R.V.J.)

16463 ANION-EXCHANGE SEPARATION OF Zn, Cd, Cu, Pb, Bi, AND Ag. M. N. Zvereva and N. I. Vinogradova. Vestnik Leningrad. Univ., No. 10, Ser. Fiz. i Khim., No. 2, 142-4(1962). (In Russian)

It is shown that Zn, Cu, Cd, Pb, Bi, and Ag can be separated quantitatively by anion-exchange resin (10g; particle size 0.25–0.50 mm, diameter of the column 10–13 mm; flow rate 1–2 ml/min). Elution began with 2$\underline{M}$ HCl, which removed Cu, but retained Zn, Cd, Pb, Bi, and Ag in the column. Zn was then removed with 0.65$\underline{M}$ HCl; Cd–0.25$\underline{M}$ HCl; Pb–H_2O; Bi–5$\underline{M}$ H_2SO_4; Ag–3$\underline{M}$ NH_4OH. (auth)

16464 REACTOR FUEL PROCESSING. Technical Progress Review, Vol. 4, No. 3. Stephen Lawroski, ed. (Argonne National Lab., Ill.). July 1961. 67p.

Information is given regarding commercial aspects of fuel processing, including data on the production and properties of Po^{210}, Cm^{242}, Pu^{238}, Ce^{144}, Pm^{147}, Cs^{137}, and Sr^{90} radionuclide heat sources. A criticality incident at Idaho Chemical Processing Plant is described. The chemical explosion characteristics of TBP-uranyl nitrate-nitric acid systems are investigated. The preparation of fuels for processing is studied, with particular attention to chemical dejacketing and dissolution procedures. Improvements are described in solvent extraction, ion exchange, volatility, fused salt, and pyrometallurgical fuel processing methods. Means for controlling corrosion in these processes are discussed. Waste disposal systems and operations are described, including low-level liquid waste handling, reduction to solids, final disposal, and separation of specific isotopes. The production and recovery of U and Th and their compounds are described. One hundred and seventy-eight references. (T.F.H.)

16465 PROCESS FOR GRAPHITE PURIFICATION. Bushnell Best (to Great Lakes Carbon Corp.). British Patent 894,441. Apr. 18, 1962.

A method is given for removing metallic impurities from graphite articles to be used as electrolytic cell anodes and in reactor structures. The method comprises heating the articles in the presence of a chlorinated hydrocarbon having a boiling point >200°C, to a temperature high enough to form and volatilize the chlorides of the impurities. Preferably, this temperature is at least 1000°C. (D.L.C.)

16466 IMPROVEMENTS IN REMOTE CONTROL DEVICES FOR OPENING TUBULAR CONTAINERS. Michel Douis, Jacques Jouin, Henri Laurent, Jean Godart, and Michel Sougi (to Commissariat á l'Énergie Atomique). British Patent 894,929. Apr. 26, 1962.

An improved device is designed for the clean opening of a tubular container emitting radiation or containing radioactive materials. The device comprises first means for holding a container, second means for moving a sharp tool to cut the container, and remote control means for controlling the operation of first and second means from behind a protective screen. (D.L.C.)

16467 METHOD OF REMOVING STRONTIUM IONS. Donald W. Rhodes, John R. McHenry, and Lloyd L. Ames, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,032,497. May 1, 1962.

A method is given for removing trace amounts of Sr^{90} from solutions. Phosphate ion is added to the solution and it is then brought into contact with a solid salt such as calcium carbonate which will react metathetically with the phosphate ion to form a salt such as calcium phosphate. During this reaction, strontium will be absorbed to a high degree within the newly formed lattice. (AEC)

16468 PRECIPITATION OF PLUTONOUS PEROXIDE. B. F. Faris (to U. S. Atomic Energy Commission). U. S. Patent 3,033,645. May 8, 1962.

A precipitation process is given for separating and recovering plutonium values contained in an aqueous solution. Hydrogen peroxide is added to an aqueous solution containing plutonium values which is maintained at about 20°C. The resulting plutonous peroxide-containing solution is then cooled to 0 to 10°C, maintained within this temperature range for a period of time sufficient to promote settling of the precipitate, and the plutonous peroxide and supernatant liquid are then separated. (AEC)

16469 SEPARATION OF CALIFORNIUM FROM CURIUM BY SOLVENT EXTRACTION. Donald F. Peppard and George W. Mason (to U. S. Atomic Energy Commission). U. S. Patent 3,034,854. May 15, 1962.

A process is given for selectively extracting californium away from curium present in an aqueous 0.01 to 1 $\underline{M}$ hydrochloric acid solution. The extractant is a 0.001 to 1.5 $\underline{F}$ toluene solution of either 2-ethyl hexyl hydrogen monochloromethyl phosphonate or 2-ethyl hexyl hydrogen phenyl phosphonate. The californium can be back-extracted from the phosphonate with a 1 to 6 $\underline{M}$ mineral acid. (AEC)

16470 CONTINUOUS TREATMENT APPARATUS. Eugene E. Erickson (to U. S. Atomic Energy Commission). U. S. Patent 3,034,868. May 15, 1962.

An apparatus is described for dissolving a nuclear reactor fuel element in strong acid solution. The vapors and entrained liquid resulting from the violent reaction of dissolution are led into a reflux condenser which discharges, not directly back into the top of the reaction vessel in the conventional manner, but by a route leading to the bottom of the apparatus, thereby utilizing the energy of the reaction to bring about a circulation of the solution. (AEC)

16471 DECONTAMINATION OF URANIUM. Frank H. Spedding and Thomas A. Butler (to U. S. Atomic Energy Commission). U. S. Patent 3,034,889. May 15, 1962.

A process is given for separating fission products from uranium by extracting the former into molten aluminum. Phase isolation can be accomplished by selectively hydriding the uranium at between 200 and 300°C and separating the hydride powder from coarse particles of fission-product-containing aluminum. (AEC)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

Refer also to abstracts 16062, 16063, 16064, 16065, 16068, 16071, and 16072.

16472 (AROD-2465.1) DEFORMATIONS AND STABILITY OF SPHERICAL SHELLS UNDER ACTION OF CONCENTRATED LOADS. Technical Report No. 2, September 11, 1960—September 30, 1961. R. M. Evan-Iwanowski, H. S. Y. Cheng, and T. C. Loo (Syracuse Univ., N. Y. Research Inst.). 89p. (SURI-834(I)-2)

Analytical and experimental investigations on the deformations and stability of shallow and deep spherical shells with simply supported and clamped edge conditions were conducted. Analysis indicated that the clamped shells do not exhibit snap-through phenomenon, which was confirmed by experimental work. Experiments on the simply supported shells were carried out over an extended range of geometry parameter $\lambda(\lambda^4 = a^2\{12\ (1-\nu^2)\ Rt\})$. It was established that for very shallow shells with $\lambda < 3.7$ there is no buckling instability; for $3.7 < \lambda < 10.2$ the deformations and buckling modes are symmetrical about the load point, and for $10.2 < \lambda$ the prebuckling deformations are asymmetrical and the buckling occurs about the meridional lines of shells. The critical values of simply supported shells agreed well with known analytical results, notably Biezeno's, Chien's, and Ashwell's over a limited range of λ. Analytical solutions, using one term approximations, did not yield satisfactory results, and higher order approximations are in progress. The ratio h/a did not affect critical values, and $h/a = {}^1\!/_8$ used as a dividing line between shallow and deep shells did not indicate any marked difference in shell behavior, it was rather the value $h/a = {}^1\!/_6$ which indicated the differences in the center deflections at the critical loads. "Deep" shells clamped and simply supported did not exhibit any snapping. The stresses vanished rapidly away from the deformed ridges. (auth)

16473 (HW-71980) AXIAL EXPANSION OF LATHE SPINDLES. J. H. Rector (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1961. Contract AT(45-1)-1350. 17p.

Spindle axial location must be accurately maintained while contours are being precision machined with a tracer lathe. To determine existing inaccuracies, spindle expansion of three lathes was measured for various operating conditions. In all cases, when the spindle rpm was varied (200-660) to simulate approximate constant surface cutting speeds, the axial expansion was too large (0.00005 to 0.00025 inch) for ultra precision contour work. If present lathes are to machine at their highest accuracy, they must be operated at a constant spindle rpm. Future lathes purchased for this work should have the necessary stability for variable spindle speed operation. (auth)

16474 (MCW-1455) A STUDY OF SAMPLE BOTTLES AND BOTTLE-SEALING METHODS. S. D. Nelson, T. J. Kneip, and A. H. Mohl (Mallinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.). Apr. 20, 1962. Contract W-14-108-Eng-8. 8p.

A study was made of sample bottles and sealing methods for use in U concentrate sampling. The bottles studied include half-pint Kerr bottles and 7-oz. and 15-oz. snap-lid vegetable bottles of the kind formerly used for baby foods. The hot-bottle-sealing technique was used for each bottle type, and some Kerr bottles were also tested after being sealed by a hot-lid-sealing method. These sealed bottles, half of which contained water and half of which contained magnesium perchlorate, were then subjected to rough handling, a wide range of ambient temperatures, or both before placement in controlled-humidity atmospheres. The bottles were weighed back periodically to determine the weight changes due to the leakage of moisture through the seals. The effectiveness of these seals varied considerably between bottle types. If low leakage through the seals and small variation among individuals are used as criteria, the Kerr bottles are best, followed by the 7-oz. and 15-oz. snap-lid bottles in that order. Each of these bottle types differs from the others by a significant amount; a small, but sometimes significant, difference is also observed between the hot-lid-sealed and hot-bottle-sealed Kerr bottles. Other advantages found for the Kerr bottles were the lower frequency of occurrence of gross leaks, the ease with which a loss of seal may be detected, and the elimination of spillage which sometimes occurs when the snap-lid bottles are opened. (auth)

16475 (NP-11494) EXPERIMENTAL INVESTIGATION OF WHIRL IN SELF-ACTING AIR-LUBRICATED JOURNAL BEARINGS. D. B. Reynolds and W. A. Gross (International Business Machines Corp. Research Lab., San Jose, Calif.). Oct. 27, 1961. Contract Nonr 3448(00). 60p. (RJ-198; ONR-4)

Bearing characteristics influencing the threshold speed at which large-amplitude self-excited whirl occurs in complete, air-lubricated journal bearings were experimentally investigated. Various combinations of rotors having clearance ratios, $\Psi = c/r$, ranging from 0.000268 to 0.002350 and symmetrical bearing assemblies having slenderness ratios, $L' = L/D$, ranging from ¼ to 1 were tested. By varying slenderness and clearance ratios and unit load, by opening or closing supply orifices, or by adding unbalance, the whirl threshold speed could be varied between zero and the limit set by the available power. Experimental methods of identifying the cylindrical and conical modes of synchronous and self-excited whirl are described. The whirl hysteresis region and the nature of whirl at speeds above the threshold are examined. Three methods of avoiding large-amplitude self-excited whirl are discussed. (auth)

16476 (NYO-9457) SOME METHODS OF SURFACE ANALYSIS FOR THE PREDICTION OF THERMAL RESISTANCE OF METAL CONTACTS. Progress Report, September 1960-October 1961. (Massachusetts Inst. of Tech., Cambridge). Nov. 1, 1961. Contract AT(30-1)-2078. 61p.

Equations for the heat-transfer coefficient existing at the interface of two metals in contact are discussed. The results of applying the equations (with a graphical determination of the geometric parameters) to an iron–aluminum contact are presented. A method is given for performing the graphical analysis by means of a general purpose analog computer. Data are included that were obtained by applying this method to Blanchard ground stainless steel surfaces in contact. Statistical analysis was applied to surfaces to determine the geometric properties of the contact as a function of root-mean-square roughness and method of surface preparation. (M.C.G.)

16477 (TIM-390) AN ANALYSIS OF PERFORATED BEAMS IN BENDING USING BOTH ANALYTICAL AND EX-

PERIMENTAL METHODS. A. J. Richardson and J. D. Sutherland (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Apr. 3, 1957. Contract [AT(11-1)-229]. 22p. (TID-12288)

Stresses and deflections in beams with perforations on a triangular layout during bending were analyzed. A comparison was made with deflections calculated by Horway's method and stresses calculated on a ligament basis using beam and torsion formulas. The beams, in testing, were loaded until several similarly oriented ligaments showed a stress coat crack. The major principal stress was calculated for the load at which the cracks appeared. The average difference between calculated and strain gage stresses was 16.5%, calculated stresses being higher. Treating the perforated beam as a hexagonal ligament array to find the loading on the various ligaments, then calculating ligament stresses by beam and torsion formulas gave good correlation with test results. (M.C.G.)

16478 (TIM-408) DISCONTINUITY ANALYSIS OF A CYLINDRICAL PRESSURE VESSEL HAVING AN ELLIPSOIDAL HEAD AND A SHORT HEAD-TO-CYLINDER TRANSITION SECTION. D. W. McLaughlin (Pratt and Whitney Aircraft Div., United Aircraft Corp., Middletown, Conn.). July 8, 1957. Contract [AT(11-1)-229]. 20p. (TID-12287)

A pressure vessel with an ellipsoidal head in which the head was made thicker than the cylindrical portion was analyzed to find the elastic stresses and deflections at the discontinuities. The area which was studied consists of three shells: a semi-infinite thin-walled cylinder, a thicker ellipsoidal head, and a short transition section between the two which is treated as a cylinder of varying wall thickness. It was assumed that the transition section is short enough for the discontinuity forces at one end to affect those at the other end so that the two junctions must be studied simultaneously. Equations were derived, a sample calculation made, and the discontinuity forces and stresses at each of the junctions were found. (M.C.G.)

16479 (TIM-438) TEST OF P2 VERSION OF PESCO PUMP IN 2000 GPM WATER LOOP. M. E. Carroll, Jr. (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Dec. 31, 1957. Contract [AT(11-1)-229]. 28p. (TID-12291)

In order to verify and improve the trust prediction system for use in the design of turbopumps, tests were conducted on a modified version of the 1600 GPM liquid metal pump. The method used consisted of correlating the predicted axial thrust with the measured axial thrust and correlating predicted internal pressures with measured internal pressures. Since the internal pressures produce the various force components which result in the net axial thrust, correlation of predicted and measured pressures has the same effect as correlating thrust. In addition, hydraulic performance, dynamic seal performance, and stationary vane performance were determined. (auth)

16480 (WADD-TR-60-821(Pt.II)) A NITROSYL CHLORIDE SOLAR REGENERATIVE FUEL CELL SYSTEM. W. E. McKee, E. Findl, J. D. Margerum, and W. B. Lee (Sundstrand Aviation-Denver. Engineering and Testing Labs., Pacoima, Calif.). June 1, 1961. Contract AF33(616)-6585. 131p. (AD-267060)

The experimental work accomplished during the period of October 1960 to April 1961 in the development of the nitrosyl chloride solar regenerative fuel cell system is described. Regeneration is accomplished utilizing solar energy to dissociate nitrosyl chloride into nitric oxide and chlorine. Product separation is accomplished using solvent extraction techniques. The separated dissociation products are used as fuels in a carbon electrode, ambient temperature fuel cell. A breadboard model photoregeneration system was designed and built as a function of compliance with the terms of the contract. Discussed herein are data relating to the model fabrication, preliminary system tests, separation of regenerated fuels and the development of the nitric oxide-chlorine fuel cell. Encouraging progress was made in the performance of the non-regenerated nitric oxide-chlorine fuel cell. Current densities up to 8.5 amps/ft^2 at about 75% of the theoretical cell voltage (0.21 volts) were achieved. In preliminary system tests, solar energy was converted into electricity for the first time by a photochemically regenerated fuel cell system employing product separation. Although conversion efficiencies in these few tests were very low, the photochemical process for storing and converting solar energy was thus demonstrated. (auth)

16481 (WT-722) TESTS ON THE LOADING OF HORIZONTAL CYLINDRICAL SHAPES. Eugene Sevin (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Oct. 1955. Project 3.3 of Operation UPSHOT-KNOTHOLE. Contract AF33(038)-30029. 108p. (WADC-TR-55-420)

Tests on the loading of horizontal cylindrical shapes were conducted to increase blast loading knowledge. Pressure data exhibited a random behavior and strain data yielded no quantitative results. (F.S.)

16482 (WT-740) PRESSURE MEASUREMENTS ON STRUCTURES. L. M. Swift (Stanford Research Inst., Menlo Park, Calif.). Mar. 1954. Project 3.28.3 of Operation UPSHOT-KNOTHOLE. 35p.

Measurements were made of pressures resulting from atomic explosions existing on the surfaces of various nonresponsive structures. Results are reported from measurements of side-on pressure and from studies of the effects of stabilization of surfaces on the effect of the blast wave. Conclusions as to the shielding effect of a 3-dimensional structure are included. (C.H.)

16483 ACUTE PROBLEMS. PORTABLE NEUTRON SOURCE FOR PERMANENT AND PULSED OPERATION. H. Horstmann (Christian-Albrechts-Universität, Kiel). Kerntechnik, 4: 119-20(Mar. 1962). (In German)

The deuterium–tritium reaction in a metal tube was used as a source of neutrons for continuous and pulsed operation. The possibility of constructing a compact neutron tube furnished with an accelerator is presented by allowing the ion source and acceleration system to work under the same gas pressure. An improved Renning-source was used. In order to keep the gas pressure in the neutron tube constant, the tube contained a small zirconium wire saturated with heavy hydrogen and bearing an electric potential. By varying the temperature of the wire and consequently the absorption and release of hydrogen the gas pressure could easily be adjusted. The neutron tube produces 2×10^8 neutrons/sec in continuous operation and neutron impulses of 3×10^{10} neutron/sec maximum. (M.C.G.)

16484 DEVELOPING FACE SEALS FOR ROTATING SHAFTS. M. G. Marsh (Napier Aero Engines, Ltd., [Eng.]). Nuclear Eng., 7: 149-51(Apr. 1962).

The design and performance of a combined thrust bearing and an annular face seal originally developed for the hydrogen blower on a 60 Mw turbo-alternator and an air-lubricated face seal used in the Zenith coolant circuit blower are described. (N.W.R.)

16485 DEMAGNETISING DEVICES. Georges Bonnet and Roger Gariod (to Commissariat à l'Énergie Atomique). British Patent 893,609. Apr. 11, 1962.

A circuit is described for producing a magnetic field of progressively reducing amplitude and zero mean value for demagnetizing ferromagnetic materials. The circuit includes a coil and a network for transmitting electric power from a source to the coil. (D.L.C.)

16486 IMPROVEMENTS IN OR RELATING TO LABORATORY CENTRIFUGES. Clive Jackson (to United Kingdom Atomic Energy Authority). British Patent 893,737. Apr. 11, 1962.

A small laboratory centrifuge operable at high rotational speeds is designed for insertion into a glove box and for remote manipulation. The centrifuge comprises a vessel of inverted conical or frusto-conical shape and provided with a centrally apertured cover and with means for end-mounting on the spindle of a driving motor. In operation, solids are packed against the top of the bowl, and when the centrifuge stops, the clear liquid drops away from the packed solid matter and may be drawn off by a suction tube. (D.L.C.)

16487 SELF ENGAGING COUPLINGS. Stephen Baldwin Dunwich Fletcher and Lamberto Paggi (to Nuclear Power Plant Co., Ltd. and Agip Nucleare). British Patent 894,471. Apr. 26, 1962.

A self-engaging coupling is designed for locking a plug in a standpipe communicating with a reactor pressure vessel. The coupling is a ball cage and a ring of balls arranged so that it is impossible for a pressure difference across the plug to release the coupling. (D.L.C.)

16488 IMPROVEMENTS IN OR RELATING TO TABLES FOR POSITIONING PATIENTS FOR EXAMINATION AND TREATMENT BY MEANS OF X-RAYS, GAMMA RAYS, OR THE LIKE. (to Siemens-Reiniger-Werke A. G.). British Patent 894,500. Apr. 26, 1962.

A table is designed with at least one recess for irradiation and/or x-ray examination of a patient from beneath the table. The table is at least 2.4 meters long, and the recesses are formed on one of the longer edges at a distance from one end equal to $\sim\frac{1}{3}$ of the table length. Thus, irradiation of any part of the body from beneath the table can be carried out in the recess by moving the body up or down the table. (D.L.C.)

16489 AN IMPROVED METHOD OF MANUFACTURING HEAT EXCHANGER TUBES AND IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGER TUBES AND TO HEAT EXCHANGERS. William Robert Wootton (to Babcock & Wilcox Ltd.). British Patent 894, 883. Apr. 26, 1962.

A method is given for manufacturing a long heat exchanger tube with inner and outer walls. The method comprises staggering short lengths of inner and outer tubes so that butt welding of two inner tube ends can be done first, followed by butt welding of the outer tube ends, and subjecting the inner tubes to internal fluid pressure to expand them against the outer tubes. Leak detection means are described. (D.L.C.)

16490 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF MEMBRANE FILTERS. Gerhard Schmid (to Membranfilter-Gesellschaft G.m.b.H.). British Patent 895,082. Mar. 2, 1962.

A process is given for producing membrane filters of graduated pore size from synthetic resins. The process comprises the steps of forming a solution of resin in a first solvent, adding a second and less volatile solvent miscible with the first solvent but not with the resin, forming a layer from the solution, allowing the layer to mature without evaporation of the solvent, gelatinizing the layer by slowly evaporating off the solvent to yield a gel consisting mostly of the second solvent, removing the second solvent by contacting the gel with a liquid miscible with the second solvent, and drying the resulting membrane filter. The pore size of the filter is dependent on the ratio of the two solvents in the solution which is formed into the layer. An example of the process is given in which the resin is polystyrene, and the resulting membranes can be sulfonated and then used as ion exchange membranes. The extent of sulfonation possible on the membranes is limited but can be increased by radioinduced crosslinking. (D.L.C.)

16491 IMPROVEMENTS IN OR RELATING TO CENTRIFUGES. Brian Howard Kaye (to United Kingdom Atomic Energy Authority). British Patent 895,222. May 2, 1962.

A centrifuge apparatus is designed for particle size analysis of powder samples. The apparatus comprises a hollow cylindrical tank of polystyrene mounted for rotation about its principal axis, a light beam, a photocell connected to a servo motor, a chopper mirror for dividing the beam into two paths, means for passing one path through the tank to the photocell, and an optical wedge mounted in the other path. In operation, if the two paths differ in intensity, the photocell causes the servo motor to rotate the optical wedge until the intensities are equal, and an indication of particle size can then be found on a scale on the servo motor. (D.L.C.)

16492 IMPROVEMENTS IN OR RELATING TO BRAZING TORCHES. James Roy Adair (to United Kingdom Atomic Energy Authority). British Patent 895,245. May 2, 1962.

A brazing torch is designed for brazing and soldering operations on reactive metals. The torch comprises an arc chamber with a gas inlet and outlet, a first arc electrode in the arc chamber, and a second arc electrode positioned across the outlet to confine the arc within the chamber. The arc is struck with an inert gas such as argon, and the gas exhaust through the holes gives a hot flame. (D.L.C.)

16493 HYDRAULIC SERVO. David E. Wiegand (to U. S. Atomic Energy Commission). U. S. Patent 3,031,846. May 1, 1962.

A hydraulic servo is designed in which a small pressure difference produced at two orifices by an electrically operated flapper arm in a constantly flowing hydraulic loop is hydraulically amplified by two constant flow pumps, two additional orifices, and three unconnected ball pistons. Two of the pistons are of one size and operate against the additional orifices, and the third piston is of a different size and operates between and against the first two pistons. (AEC)

16494 EXPLOSIVE MEANS TO SEPARATE CASING MEMBERS. N. B. Botsford (to U. S. Atomic Energy Commission). U. S. Patent 3,032,356. May 1, 1962.

This patent relates to a case having separable sections with intermediate interfitting tongue and groove portions. An explosive or gas generator between the tongue and groove forces them apart, when actuated, and serves to separate the case sections. (AEC)

16495 CABLE CONNECTOR. J. M. Caller (to U. S. Atomic Energy Commission). U. S. Patent 3,034,088. May 8, 1962.

An electrical connector is designed for utilization in connection with either round or flat coaxial cables. The connector comprises a bayonet-type coupling arrangement with a splined movable locking sleeve adapted to lock together components of the connector. A compression spring is attached to one of the connector components and functions to forcibly separate mating components when the locking sleeve is in an unlocked condition so as to minimize the possibility of leaving the conductors electrically coupled. (AEC)

16496 COUPLING. E. Frisch and C. G. Johnson (to U. S. Atomic Energy Commission). U. S. Patent 3,034,814. May 15, 1962.

A detachable coupling arrangement is described which provides for varying the length of the handle of a tool used in relatively narrow channels. The arrangement consists of mating the key and keyhole formations in the cooperating handle sections. (AEC)

16497 ULTRA HIGH VACUUM VALVE. W. A. Fry (to U. S. Atomic Energy Commission). U. S. Patent 3,036,811. May 29, 1962.

A valve for high vacuum applications such as the C-Stellarator where chamber pressures as low as 2×10^{-10} mm Hg are necessary is designed with a line-of-sight path through the valve for visual inspection of the contents of reactants in such chambers. The valve comprises a turnable resilient metal ball having an aperture therethrough, means for selectively turning the ball to rotate the axis of its line-of-sight path, and soft, deformable opposing orifices that are movable relatively toward said ball to seal with opposite ball surfaces upon said movement of said axis of said line-of-sight path. The valve also includes a bellows seal connected between said orifices and internal actuating means that eliminates the requirement for gasketed turnable valve closing stems. (AEC)

Heat Transfer and Fluid Flow

Refer also to abstract 16073.

16498 (AEEW-R-123) FLOODING VELOCITIES FOR AIR AND WATER IN VERTICAL TUBES. G. B. Wallis (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Dec. 1961. 17p.

An investigation of the limiting, or flooding, velocities for countercurrent annular flow of air and water in vertical tubes is reported. The data are correlated in terms of dimensionless groups which are similar to those already in use for describing flooding in packed towers. The relevance of the results to the problem of burnout in boiling equipment is discussed. (auth)

16499 (CEA-Bib-28) FLUX DE CHALEUR CRITIQUES EN DOUBLE PHASE EAU-VAPEUR ET EN CONVECTION FORCEE ETUDE BIBLIOGRAPHIQUE. (Literature Survey of Burnout Heat Fluxes for Two-Phase Water-Steam in Forced Convection). A. de La Harpe (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Grenoble). 1961. 42p.

The known causes of burnout heat flux are reviewed. The main formulas of correlation found in the most recent literature are presented together with their limits of validity. The important discrepancy existing between those different formulas are explained and the influence on burnout heat fluxes of the different parameters are shown. (auth)

16500 (DC-59-11-57) EFFECT OF A BODY INTERSECTING A FLOW CHANNEL. Thermodynamics and Mechanics Development Report No. 580. James L. Mason (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 6, 1959. Contract AT(11-1)-171. 55p.

During the investigation of cooling flow distribution in the external side shield the question of the effect of a body (nuclear sensor well) intersecting the coolant flow channels was brought to light. Recognizing that an intersected channel was in essence many individual passageways created by the corrugated fin (hat section) structural pieces, it was decided to investigate the necessary techniques (if any) to maintain flow in these individual passageways along with cooling in the wake of the body. The suggested techniques were removal of the fins in the region of the interfering body and alteration of the fins in this region to provide continuous flow passages around the body. Experimental results obtained in the investigation of these techniques are presented. (auth)

16501 (EURAEC-147) SYNTHESIS OF THERMAL TESTS. Special Report No. 6. C. Moussez (Société Nationale d'Etude et de Construction de Moteurs d'Aviation. Division Atomiques, Suresnes, France). July 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract 017-60-4RDF. 25p.

Explanations of observed phenomena with particular reference to those taking place at the moment of heating are discussed. A survey of problems encountered in the tests and with the installations is also included. (J.R.D.)

16502 (FXM-208) SODIUM POTASSIUM ALLOY TO MERCURY BOILER. George Costomiris (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Sept. 11, 1952. Contract [AT(11-1)-229]. 18p.

A conventional, unbaffled tube and shell heat exchanger and a Trane surface using parallel counterflow were analyzed for use as a NaK to Hg boiler to determine the combination of dimensions that would result in minimum weight. The calculational procedure used is outlined. A table of exchanger dimensions used and resulting weights is included. (M.C.G.)

16503 (NP-11491) THE MECHANISM OF HEAT TRANSFER IN NUCLEATE POOL BOILING. Technical Report No. 19. Chi-Yeh Han and Peter Griffith (Massachusetts Inst. of Tech., Cambridge. Heat Transfer Lab.). Feb. 1962. Contract NONR-1841(39). 81p. (DSR-7-7673)

A criterion is developed for bubble initiation from a gas-filled cavity on a surface in contact with a superheated layer of liquid. It is found that the temperature of bubble initiation on a given surface is a function of the temperature conditions in the liquid surrounding the cavity as well as the surface properties themselves. It is also found that the delay time between bubbles is a function of the bulk liquid temperature and the wall superheat and is not constant for a given surface. By consideration of the transient conduction into a layer of liquid on the surface, a thermal layer thickness is obtained. With this thickness and a critical wall superheat relation for the cavity, a bubble growth rate is obtained. Bubble departure is considered and it is found that the Jakob and Fritz relation works as long as the true (non-equilibrium) bubble contact angle is used. The effect on the departure size of the virtual mass in the surrounding liquid is found to be negligible at one gravity. That is, at one gravity the primary effect of bubble growth velocity on bubble departure size is found to be due to contact angle changes. The initiation, growth, and departure criterions are each experimentally and individually checked. They are then used to compute the heat transfer near the knee of the boiling curve using only an experimental determination of the number of bubbles as a function of wall superheat and other known quantities. Finally the q vs. $T_w - T_{sat}$ relation is computed and measured and compared. The comparison is satisfactory. (auth)

16504 (TID-15429) STUDY OF A TWO-PHASE COMPRESSIBLE FLOW BY A "GROWING BUBBLE" MODEL.

Bimonthly Report No. 11. G. Gavalas (Minnesota. Univ., Minneapolis). Mar. 1962. Contract [AT(11-1)-926]. 22p.

An examination was made of vaporization in a steam–water mixture during flow through an aperture. A physical description of the vaporization process is presented. The model used for the detailed calculation is also described. Equations of change for a growing bubble are given. Variation of pressure with time is discussed. Calculations were made of mass and momentum flow rates. (M.C.G.)

16505 (TIM-280) ACOUSTICAL BEHAVIOR OF HEAT EXCHANGERS. H. N. Schenck, Jr. (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Oct. 8, 1956. Contract [AT(11-1)-229]. 15p.

A theory of acoustic vibration applicable to vibration problems in radiator performance testing is discussed. The small-scale disturbances that may be present in a heat exchanger are considered. The resonant systems in which strong standing waves may be established were examined. The resonant behavior of the longitudinal space between tube rows, perpendicular to the gas-flow direction was investigated. During performance testing of a tube-and-plate-fin radiator, a piercing whistle was heard at higher air flows. Use of the theory in calculation of the frequency of the whistle gave reasonably close agreement to the measured frequency. The applicability of the theory was proved by baffling the radiator as it suggested. Studies were also made on a 90° condenser test core. Applications of these results to future tests and designs are discussed. (M.C.G.)

16506 (WADD-TN-60-238) THE EFFECT OF PARA-ORTHO SHIFT ON HEAT EXCHANGER DESIGN IN HYDROGEN NITROGEN HEAT EXCHANGE AT HIGH PRESSURES. Period Covered May 1960 to June 1960. James H. L. Lawler (Wright Air Development Div. Materials Central, Wright-Patterson AFB, Ohio). Oct. 1960. 32p.

The effect of para-ortho shift is found on heat exchanger design by calculating heat exchanger sizes for several hydrogen to nitrogen flow ratios. This calculation showed that size is exponential to a limit when plotted against lbs of H_2/lbs of N_2 ($\#H_2$) flow and that para-ortho shift has a pronounced effect above $5\#H_2/\#N_2$. (auth)

16507 (UCRL-Trans-785(L)) TURBULENT FLOW OF COMPRESSED GAS IN CHANNELS. G. G. Chern'ii (Chernyi). Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Izvest Akad. Nauk S.S.S.R., Otdel, Tekh. Nauk, No. 6, 55-62(1956). 12p.

The case of an adiabatic reversible and steady-state ideal gas motion in a flow column is considered. It is assumed that flow parameters are constant with respect to the flow column cross section. An approximation is developed in which the cross sectional area of the flow column and the total momentum of flow in the axial direction are independent of the nonuniformity of the static and total pressures and of the retardation temperature. The methods of averaging nonuniform flow with conservation of input, total heat content flow, and entropy flow are equivalent with conservation of input, total heat content flow, and total momentum in the linear approximation. (J.R.D.)

16508 FILM BOILING ON A HORIZONTAL PLATE. E. R. Hosler (Westinghouse Electric Corp., Pittsburgh) and J. W. Westwater. ARS (Am. Rocket Soc.) J., 32: 553-8 (Apr. 1962).

Film boiling is studied for water and Freon-11 (CCl_3F) at atmospheric pressure on a flat horizontal aluminum heating surface 8 in. square. High speed motion pictures were taken from which interbubble distances, bubble periods, breakoff diameters, and geometric arrangement of bubbles were determined. The results show that the minimum heat flux in film boiling from a horizontal surface is definitely a type of Taylor hydrodynamic instability. A new experimental technique was developed for obtaining film boiling on a large area without the necessity of using huge heat fluxes to go over the peak of the boiling curve. Once film boiling was established, the film boiling region could be traversed by changing the heat output from the gas burner beneath the slab. (auth)

16509 RESEARCH ON THE NUMERICAL DETERMINATION OF ONCE-THROUGH STEAM PRODUCERS FOR GAS-COOLED REACTORS. W. E. Bausa (Deutschen Babcock and Wilcox-Dampfkelles-Werke A.G., Oberhausen, Ger.). Atomkernenergie, 7: 15-20(Jan. 1962). (In German)

A usable method to determine transients occurring in complicated steam generator systems is developed. At a surface element the differential equations of the tube wall temperature and the temperatures of the fluids were deducted. Transforming these equations into difference equations one can consider changes in state of phase in the once-through system. The resulting step-by-step-method also can be used in case of steam generator units with reheaters or two pressure systems, which often are found in connection with gas-cooled reactors. (auth)

16510 MICROMANOMETER AND PITOT TUBE FOR MEASURING THE VELOCITY DISTRIBUTION IN A NATURAL CONVECTION WATER STREAM BETWEEN TWO VERTICAL PARALLEL PLATES. Lucien Santon and Philippe Vernier (Centre d'Études Nucléaires, Grenoble, France). Compt. rend., 253: 780-2(July 31, 1961). (CEA-2058) (In French)

For heat transfer studies in certain cases of cooling in swimming-pool type nuclear reactors, a knowledge of the distribution of the velocities between two heating elements is of prime importance. A pitot tube and a micromanometer are described for making these measurements on an experimental model. (auth)

16511 PROFILING OF A THERMAL LOAD ALONG THE LENGTH OF A REACTOR CHANNEL TAKING INTO ACCOUNT IRREGULARITIES OF HEATING OF THE HEAT TRANSFER AGENT. N. N. Ponomarev-Stephnoĭ. Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 5: No. 2, 42-6(Feb. 1962). (In Russian)

The profiling of a heat load along the length of a reactor channel is considered on condition that the factor limiting the power take-off from the reactor is the maximum attainable temperature of the heat-producing elements. The problem of profiling is solved taking into account the possible irregularities of temperature in the reactor. The problem is considered of decreasing irregularities in the heating of a heat transfer agent by introducing mixed zones. The condition for choosing optimal disposition of the mixed zones when their quantity is given is obtained. (auth)

16512 THE BOUNDARY LAYER ON A MAGNETIZED PLATE. M. B. Glauert (Univ. of Manchester, Eng.). J. Fluid Mech., 12: 625-38(Apr. 1962).

The magnetohydrodynamic boundary layer in an incompressible viscous electrically conducting flow past a semi-infinite flat plate is studied for the case where a uniform magnetic field in the stream direction is applied at the plate. For both large and small values of the electric conductivity parameters, solutions in series are derived for the velocity and magnetic fields. In each of the cases it is shown that if the strength of the applied field exceeds a certain critical value, boundary-layer separation occurs. (N.W.R.)

Instrumentation

Refer also to abstracts 16090, 16092, 16093, 16099, 16101, 16134, 16135, 16136, 16137, 16138, 16139, 16140, 16141, 16142, 16143, 16144, 16145, 16146, 16148, 16150, 16155, 16156, 16158, 16159, 16161, and 16162.

16513 (AE-64) MODIFIED SUCKSMITH BALANCES FOR FERROMAGNETIC AND PARAMAGNETIC MEASUREMENTS. N. Lundquist and H. P. Myers (Aktiebolaget Atomenergi, Stockholm). Feb. 1962. 8p.

Two balances, one for measurement of ferromagnetic magnetization, the other for paramagnetic susceptibility measurements, are described. Designs are based on Sucksmith's ring balance but the ring and optical lever system of the latter was replaced by a strain gage bridge, which allows the force on the magnetic specimens to be determined via potentiometer readings. The modified balances are very robust, insensitive to vibration and, if desired, suitable for direct recording. Relative accuracies of 0.3% and 0.5% are obtained respectively for the ferromagnetic and paramagnetic systems. (auth)

16514 (AFCRL-1092) AN ARRAY FOR THE INVESTIGATION OF COSMIC-RAY EXTENSIVE AIR SHOWERS. Technical Note No. 3. U. Galil, H. Kasha, D. Ophir, Y. Oren, and K. Sitte (Israel Inst. of Tech., Haifa). Aug. 15, 1961. Contract AF61(052)-196. 49p.

A comprehensive array for the study of extensive air showers is described, consisting of a Geiger-counter hodoscope, detectors of the Cherenkov radiation accompanying the showers, and penetrating-particle detectors. Specially developed transistorized electronic circuitry for signal analysis and dekatron-tube display are also described. (auth)

16515 (AFOSR-1794) THEORETICAL STUDY OF PROBLEMS CONNECTED WITH THE SOLID STATE RASER. Robert Neusel and Mohan Lal Narchal (Saint Louis Univ.). Nov. 1, 1961. Contract AF49(638)-612. 51p.

Two papers on problems connected with the solid-state RASER are presented. Separate abstracts were prepared for each. (M.C.G.)

16516 (AFOSR-1794(p.1-14)) EIGENVALUES AND INDUCED TRANSITION PROBABILITIES FOR AN ANISOTROPIC SPIN HAMILTONIAN. Robert Neusel (Saint Louis Univ.).

The approximate energy eigenvalues of the spin Hamiltonian of the type derived by Abragam and Pryce, and the induced transition probabilities, are given. No restrictions (such as axial symmetry) are made on the elements of the tensors of second rank in the Hamiltonian. The results are valid for an orientation of the external fields with respect to the crystal axes. The electron Zeeman interaction is taken as the dominant interaction and the remaining interactions as a perturbation, except for the quadrupole interaction which is neglected. (auth)

16517 (AFOSR-1794(p.15-44)) EFFECT OF FINITE PROBABILITY ASSOCIATED WITH THE DETECTION FIELD ON THE ENHANCEMENT OF A RASER. Mohan Lal Narchal (Saint Louis Univ.).

The method of partial distributions was applied to study the effect of the input signal field strength on the enhancement and signal power output of a four-level RASER amplifier. The enhancement was always found to have a finite value and was relatively insensitive to the input signal field strength for Overhauser effect experiments. For Jefferies Abragam effect experiments, the limiting enhancement was a function of the relative strength of flip-flip and flip-flop type of thermal relaxations. The dominance of electron paramagnetic relaxations and complete saturation of relevant electron paramagnetic resonance transitions was assumed. The signal power output increased from zero to a maximum value when the input signal field strength increased from 0 to ∞. (auth)

16518 (ASD-TR-61-564) A NEW FORM OF SOLID STATE SOLAR GENERATOR. Final Report. E. D. Fabricius (Giannini Controls Corp., Pasadena, Calif.). Oct. 1961. Contract AF 33(616)-7637. 70p. (RTR-79)

Valuable new information on the origin of the photoconducting electrons in the photovoltaic effect in CdS was obtained. This information is pertinent to the design and construction of metal-semiconductor solar cells, in that both the photovoltage and the efficiency of metal-semiconductor cells is dependent upon whether electrons are injected from the metal or excited across the forbidden gap of the semiconductor. An investigation was conducted on the effects of geometry, film thickness of rectifying electrode, and resistivity of CdS upon the photovoltage obtainable. A light resistivity of 300 to 600 ohm-cm at 6.3 mw/cm^2 and an electrode film thickness of 4000 to 5000 Å were found to produce the maximum photovoltage. The origin of the electrons producing the photocurrent was determined and a geometry for optimizing the photocurrent is given. Cells designed by evaporating contacts connected in series are shown to give an additive photovoltage. Suggestions for improving the efficiency are given in the light of experimental evidence. While batteries producing nine volts were not successfully constructed due to experimental difficulties, the evidence obtained verifies the feasibility of the basic design. (auth)

16519 (CEA-1931) ETUDE ET REALISATION D'UN MAGNETOMETRE A PRECESSION LIBRE NUCLEAIRE. (The Design and Construction of a Nuclear Free-Precession Magnetometer). Yves Baconnier (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 54p.

Thesis submitted to Université, Grenoble, France.

The advantages of nuclear magnetic resonance are compared with electromagnetic processes for measuring the earths' magnetic field and the macroscopic theory for the Bloch model and the Packard and Varians' experiment are analyzed. The development of a particular absolute free-precession magnetometer is studied, and the conditions are determined for obtaining a maximum amplitude signal as a function of the geometrical form of the detector coil, of the method of cut-off, and of the coupling between various parts of the system. Amplifier technology is discussed and a method is proposed for precession frequency measurement. Equipment designs are included. (auth)

16520 (CEA-2002) AMELIORATION DES METHODES DE SPECTROMETRIE DES NEUTRONS RAPIDES. (Improvements in Fast-Neutron Spectroscopy Methods). Francis Cambou (France. Institut National des Sciences et Techniques Nucléaires, Paris and France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 166p.

Thesis submitted to Université, Paris.

Research was aimed at improving fast-neutron electronic detectors based on n-p elastic scattering. The first part concerns proportional counters; careful constructional methods made it possible to plot mono-energetic neutron spectra in the range 700 kev to 3 Mev with a resolution of 7 per cent. The second part concerns scintillation counters:

an organic scintillator and an inorganic scintillator covered with a thin layer of a scattering agent. An exact study of the types of scintillation made it possible to develop efficient discriminator circuits. Different neutron spectra plotted in the presence of a strong gamma background are presented. The last part deals with the development of form discrimination methods for the study, in the actual beam, of the elastic scattering of 14.58 Mev neutrons. With hydrogen, the distribution $f(\varphi)$ of the recoil protons is $f(\varphi) = 1 + 0.034 \cos \varphi + 0.042 \cos^2\varphi$. With tritium, the scattering is strongly anisotropic; the curve representing the variation of the differential cross-section for the elastic scattering in the center of mass system is obtained with a target containing 1 cm^3 of tritium. (auth)

16521 (CEA-2093) MISE AU POINT D'UN POROSIMETRE A MERCURE. APPLICATION A L'ETUDE DES GRAPHITES NUCLEAIRES. (Development of Mercury Porosimeter. Application to Nuclear Graphite Studies). M. Bocquet, J. Genisson, and J. Sailleau (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 44p.

A mercury porosimeter, model IFP-CEA, was developed for application to nuclear graphite studies. The apparatus is based on the capillary depression phenomenon. The relationship between the radius of a pore and the pressure at which mercury fills it is $pr = 2\sigma \cos\theta$ (σ is the surface tension, θ the angle of contact of the mercury). Theoretical consideration are discussed, and the apparatus is described. The mercury pressure is increased step-wise from 0 to 1000 kg/cm^2 thus yielding the complete distribution of pores from 92 μ to 75 Å. Results are then presented concerning nuclear graphites which show the evolution of the porous structure under the effect of bitumen impregnation. In general, the volume of the large pores decreased while that of the small pores increased. The structure of impregnated products appeared to depend to a certain extent on that of the starting materials. It was also possible to study other products with this porosimeter; the range of measurements possible is such that it may be used for the study of the majority of porous materials. (auth)

16522 (CEA-2094) REALISATION D'UN APPAREIL D'ANALYSE THERMIQUE DIFFERENTIELLE. (Development of Apparatus for Differential Thermal Analysis). J. Rappeneau and M. Quetier (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 31p.

An apparatus for differential thermal analysis was developed for the study of energy stored in irradiated graphite. It makes possible measurement of variations in the differential enthalpy $dH/d\theta$ of irradiated graphite between room temperature and 800°C. Integration of the results gives values for the total energy $H(\theta)$. Temperature measurements are made with an accuracy of 0.1°C and are reproducible to ±0.2°C. The characteristics of the apparatus are such that it is possible to study, as a function of irradiation conditions (doses, temperatures), the evolution of the energy spectrum of the graphite as well as the modifications of this spectrum brought about by annealing and successive irradiations, by slow annealing, or by annealing under irradiation. The apparatus developed can also be used for study of metals and alloys (transition temperatures and heats of transformation), in particular uranium and uranium alloys. (auth)

16523 (CEA-2101) ETUDE SUR LA DETECTION DES NEUTRONS DIFFERES EN VUE DE LA DETECTION DES RUPTURES DE GAINES. (Delayed Neutron Detection in Burst Can Detection Studies). G. Perlini (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 84p.

A theoretical and experimental study on the detection of neutrons present in the primary cooling circuit of a reactor cooled by heavy or light water is described with a view to the installation of a canning burst detection unit. The concentration of background neutrons is first calculated, taking into account the neutrons from nitrogen-17 decay and the photoneutrons produced by the decay of nitrogen-16 and sodium-24. The emission of delayed fission neutrons, originating at a given crack in the canning, is estimated. Using the D_2O circuit of the pile EL 3, three units were developed by means of which the following three types of detector may be compared: (1) BF_3 proportional counter, (2) Boron scintillator, and (3) Fission chamber. Under the present experimental conditions, the BF_3 counter gave the best results. The influence on these detectors of the γ flux, which in certain cases reaches 200 r/hr, is analyzed. Finally, a calibration is carried out with an experimental crack of 30 mm^2 of uranium exposed to a flux of 5.8×10^{13} $neutrons/cm^2/sec$. The sensitivity obtained with the BF_3 counter during this test is 2 counts/sec per mm^2 of exposed uranium. (auth)

16524 (EURAEC-185) SOLID STATE NEUTRON DETECTOR. Quarterly Report No. 4, July—September 1961. (Brussels. Centre d'Étude de l'Énergie Nucléaire). Sept. 1961. Work performed under United States-Euratom Joint Research and Development Program. 13p.

Pulse annealing studies of an irradiated SiC p-n junction were made. The change of the photocurrent and the photovoltage during reactor irradiation is interpreted. The resistivity change of a p-conductive SiC single crystal during reactor irradiation was measured. A description of an oven temperature regulator for the Hall and resistivity measurements, is also given. (auth)

16525 (NP-11497) IMPROVEMENT OF A BROAD-LINE NUCLEAR MAGNETIC RESONANCE SPECTROMETER. Gerhard Englert and Richard Volpicelli (Harvard Univ., Cambridge, Mass.). Feb. 1962. Contract Nonr-1866(13). 51p.

Rebuilding work is described on a broad-line nuclear magnetic resonance spectrometer. Steps taken to improve dependability and sensitivity are described and a comparison is made concerning the sensitivity and signal-to-noise ratio of the induction and marginal oscillator spectrometer types. Experimental results are included. (J.R.D.)

16526 (SC-4667(RR)) NEW ALUMINUM OXIDE HUMIDITY ELEMENT (Second Report). C. M. Stover (Sandia Corp., Albuquerque, N. Mex.). Mar. 1962. Contract [AT(29-1)-789]. 31p.

An aluminum oxide humidity sensing element is discussed. These elements, which were developed primarily for use in radiosonde weather measuring equipment, have a fast response over the entire humidity range and through a broad temperature range of −80°F to +135°F. The elements are a marked improvement over previous humidity sensing devices, and their use in specially designed testers allows measurements to be made which were previously unobtainable. Among their other desirable features, these elements are small and lightweight, can be made inexpensively of readily available materials, and can be mass produced. (auth)

16527 (SCR-414) CERTIFICATION AND USE OF PRECISION RESISTANCE DECADES. L. W. Peacock (Sandia Corp., Albuquerque, N. Mex.). Mar. 1962. Contract [AT(29-1)-789]. 18p.

Preprinted as 22-LA-61 for; Instrument Society of America, Fall Instrument-Automation Conference and Exhibit, Los Angeles, Sept. 1961.

A study was made of testing and applications of precision resistance decades. Modifications to generally accepted test procedures resulted in greater resolution and better repeatability of measurements. Reproducibility of resistance values with selected resistance decades was analyzed. Use of selected resistance decades as reference standards in tests of other decades and Wheatstone bridge rheostat arms resulted in great savings of time with no loss in accuracy. (auth)

16528 (VUP-2202) TECHNICAL PHOTOGRAPHY OF SURFACE MOTION. VELA UNIFORM PLOWSHARE PROGRAM. Preliminary Report, Project 1.3. J. Heffernan and D. Barnes (Edgerton, Germeshausen and Grier, Inc., Boston). Jan. 1962. Project GNOME. 74p.

The technical photography of surface motion in the Gnome event is discussed. The project entailed photographic recording of earth motion in and around the surface-zero area, processing of the resultant film records, production of requested prints, analysis of the photographic records, and submission of the resultant data. The earth motion was recorded photographically from a distance by cameras equipped with long-focal length lenses and "close-in" by use of special "inertia-weight" instrumentation. In the long-range photography, the displacement of target arrays anchored in and around surface zero was photographed by cameras placed far enough distant to have finished recording the maximum earth motion before arrival of the shock wave. With the "inertia-weight" instrumentation, close-in, shock-mounted cameras recorded the displacement of marked targets in relation to a spring-suspended "inertia-weight" which remained essentially motionless during the time of interest. All but one of the fifteen cameras used to document the earth motion operated well on the Gnome event and good records were obtained. Measured maximum displacements were as follows: 69.6+ in. at 15.24 meters, 72.7+ in. at 32.32 meters, 19.65 in. at 137.20 meters, and 7.58 in. at 274.31 meters. (auth)

16529 (WT-753) EVALUATION OF CHEMICAL DOSIMETERS. John E. Chaney (Chemical and Radiological Labs., Army Chemical Center, Md.). Jan. 1955. Project 6.4 of Operation UPSHOT-KNOTHOLE. 26p.

The developmental type tactical dosimeter, Type E-1, was tested during Operation UPSHOT-KNOTHOLE. Two experimental dosimeters, the Tracerlab Tactical Dosimeter and the Consolidated Vacuum Dosimeter, were also evaluated. Along with laboratory findings and detailed data gathered under Project 29.1, the test results indicate that the tactical dosimeter, Type E-1, is rate-independent and, with the exception of the 50 r tube, records exposures in accordance with accepted film standards within the expected reading accuracy of step-type dosimeters. Recalibration studies indicated that the 50 r tubes were poorly manufactured, being sensitive to only 80 r. This recalibrated value of 80 r for the 50 r tubes correlates with field test results. The two experimental dosimeters need redesigning to withstand rugged field use, must be modified to include improved color standards, and require modification of their basic composition to record more satisfactorily gamma radiation exposure. (auth)

16530 (WT-755) EVALUATION OF MILITARY RADIAC EQUIPMENT. Joseph M. Johnston and George Poyet (Signal Corps Engineering Labs., Fort Monmouth, N. J. and Bureau of Ships). June 1954. Project 6.8 of Operation UPSHOT-KNOTHOLE. 83p.

Radiac equipment of current military interest was evaluated to determine its usability under field conditions. Information was also obtained on the maintenance burden occasioned by field use. Two production type and several experimental survey meters were evaluated. These were the AN/PDR-32(XN-3) and IM-71/PD models. In addition, a number of various types of dosimeters were tested, both of a tactical and administrative nature. Among the tactical dosimeters tested, the DT-65 model showed the most promise. The DT-60 model fulfilled the requirements as an administrative type dosimeter. (M.C.G.)

16531 (UCRL-Trans-786(L)) ON THE USE OF PHOTOMULTIPLIER TUBES AND SCINTILLATION APPARATUS. Fritz Bernhard. Translated by A. Holzer (Univ. of California Lawrence Radiation Lab., Berkeley) from Exptl. Tech. Physik, 4: 160-2(1956). 4p.

Factors which govern the application of secondary electron amplifiers in scintillation apparatus are discussed. The case where a monoenergetic β particle is absorbed in the scintillator and produces a definite number of light quanta is considered. The product fpq where f is light transmission, p is quantum yield, and q is electron transmission was developed as a figure of merit for the role of secondary electron amplifiers in a scintillation arrangement. (M.C.G.)

16532 NEUTRON-GAMMA RAY INSTRUMENTATION FOR LUNAR SURFACE COMPOSITION ANALYSIS. C. D. Schrader (Univ. of California, Livermore), J. A. Waggoner, J. H. Zenger, R. J. Stinner, and E. F. Martina. ARS (Am. Rocket Soc.) J., 32: 631-4(Apr. 1962).

A spacecraft neutron-gamma spectrometer for lunar surface compositional analysis will consist of two packages: the neutron source and the gamma detector. At the heart of the source package is a miniature nuclear accelerator using the D-T reaction to produce a pulsed beam of 14-Mev neutrons. The neutrons, on striking the lunar surface, will react to produce gamma rays that are characteristic of the elements present. The gamma rays, in turn, impinge on the detector, which consists of a NaI (Tl) scintillator and a ruggedized photomultiplier tube. The scintillation pulses are then stored in a multichannel pulse height analyzer, and the spectrum is telemetered back to Earth. (auth)

16533 CONTRIBUTION TO THE QUANTITATIVE EVALUATION OF GAMMA SCINTILLATION SPECTROGRAMS. M. Geisler and G. Brunner (Institut für Angewandte Radioaktivitat, Leipzig). Atomkernenergie, 7: 21-8(Jan. 1962). (In German)

Two simple possibilities for the analysis of complex gamma scintillation spectrographs are extensively treated: a graphical and an automatic electronic method. The graphical procedure operates with an affine-drawing apparatus and an apparatus for drawing curve distances. The base of the electronic method is the apparative possibility for subtraction of two quasi-simultaneously recorded spectrographs channel by channel in the spectrometer being used, and therefore it is of special interest for low radiation intensities. An analysis of the geometrical conditions under which the spectrographs are recorded is of importance because there is an influence on the shape of spectrographs. For this reason these conditions are carefully considered, with respect to the obtention of, the geometrical factors for activity determination of single components in mixtures of radiating substances and of isolated nuclides. (auth)

16534 FAST COUNTING SCALER WITH MULTIPLE POSSIBILITIES. Robert Sigelle (Société MESCO, Gentilly

(Seine), France). Inds. atomiques, 5: No. 11-12, 99-100 (1961). (In French)

A fast scaler suitable for adaptation to completely automatic operation is described. The 10-Mc transistorized scaler has as its principal characteristic a low resolution time, less than 0.1 μsec for a pulse triplet with amplitude ratio less than or equal to 10. The stability of the resolution time is good. The input sensitivity is controllable from 300 mv to 7 v. (J.S.R.)

16535 AUXILIARY INSTRUMENTS FOR THE OPERATION OF PROPORTIONAL COUNTER TUBES (FOR STANDARD COUNTING EQUIPMENT). R. Kurz. Kerntechnik, 4: 115-17(Mar. 1962). (In German)

A recently developed fully transistorized preamplifier (amplification factor 200) for the operation of proportional counters with any standard radiation counting units is described. Further, a 3 kv high voltage subunit operated in series with the high tension supplied by a radiation counting unit is discussed. (auth)

16536 DESIGNING OF A PERMANENT MAGNET BETA-RAY BAND-SPECTROGRAPH. I. NUCLEAR SPECTROSCOPIC PROGRAMME. Dénes Berényi and Ferenc Illés. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 3: 83-9(1961). (In Hungarian)

The reasons for constructing a beta-spectroscope are given from the viewpoint of the development of nuclear spectroscopic instruments. Also the various fields are discussed where the successful use of the spectrograph may be expected. Finally criteria are given for design and construction regarding the properties of the apparatus. (auth)

16537 DESIGNING OF A PERMANENT MAGNET BETA-RAY BAND-SPECTROGRAPH. II. PHYSICAL DESIGNING. Ferenc Illés and Dénes Berényi. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 3: 91-103(1961). (In Hungarian)

To achieve resolution of 0.01% while examining conversion lines of preparations with low specific activity, the maximal operating radius is to be raised above the present limit of ~50 cm. The full band construction of an essentially Danysz-type spectroscope of this size imply great difficulties. Thus, it seems appropriate to elaborate on a semiannular operating band in the surroundings of the maximal operating radius. The spectrum region can be brought into the operating band by applying a magnetizing coil. Main physical characteristics of the spectrograph are: maximum operating radius (ρ_{max}) 75 cm, operating band width (ρ) 15 cm, and air gap (l_g) 4 cm. A resolution of 0.001% is expected to be attained. For registering electrons, nuclear emulsion can be used. The band principle and physical sizing of the spectroscope are discussed. (auth)

16538 DESIGNING OF A PERMANENT MAGNET BETA-RAY BAND-SPECTROGRAPH. III. TECHNICAL DESIGNING. János Schadek, Dénes Berényi, and Ferenc Illés. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 3: 105-16(1961). (In Hungarian)

The outside diameter of the apparatus of ρ = 750 mm operating radius is to be 1820 mm, and its weight about 3000 kg. Designs of the vacuum chamber, source holder, beam-shutter mechanism, and casket are illustrated. Some points are given on the placing and fitting of the spectrograph. (auth)

16539 ON THE POSSIBILITY OF UTILIZING UNIVERSAL RADIOMETER OF THE "TISS" TYPE FOR THE INVESTIGATION OF BETA-ACTIVE PREPARATIONS. N. N. Alfimov, Yu. P. Alekseev, B. G. Afanas'ev, and P. N. Yagovoi (Kirov Military-Medical Order of Lenin Academy, USSR). Med. Radiol., 7: No. 3, 73-4(Mar. 1962). (In Russian)

Description is given of a device which makes it possible to use the universal TISS radiometer as a recording unit during investigations of beta-active preparations. The existing computer of the apparatus was replaced by an end-window counter of the MST-17 type fixed in a special carriage of aluminum. The experiments have divulged that without any detriment to the accuracy of studies the heavy recounting devices of the type B, B-2, DP-100 may be substituted by TISS radiometers, which have as a computer a MST-17 end-window counter fixed in the designed carriage. (auth)

16540 A FAST RESPONSE TOTAL-RADIATION DETECTOR. J. Cooper (Imperial Coll. of Science and Tech., London). Nature, 194: 269-71(Apr. 21, 1962).

A pyroelectric thermal detector with a high-frequency response of 5 μsec is described. The detector comprises a piece of polarized ferroelectric material ($BaTiO_3$) with electrodes on opposite faces. When radiation falls on one electrode face, it causes a change in the spontaneous polarization of the $BaTiO_3$, which manifests itself as a voltage across the electrodes. The restrictions on input energy due to thermal stresses are calculated, and it is indicated that reproducible results may be obtained if sufficient time (~20 sec) is allowed for the detector to return to ambient temperature between radiation pulses. (D.L.C.)

16541 PULSE ANALYZING SYSTEM FOR A GRIDDED IONIZATION CHAMBER. Masahiro Tsukuda (Rikkyo Univ., Tokyo). Nuclear Instr. & Methods, 14: 241-51(Jan. 1962). (In English)

A design method to obtain low noise amplifiers for collector pulses is described. The effect of various pulse shaping networks on minimum attainable noise charge and collection time dependence is investigated. Amplifiers having one differentiating time constant T_1 and one or two integrating networks of the same time constant T_2 seem to be the best ones when T_1 is equal to T_2. Computed minimum noise charge of a 6R-R8 input tube is 340 ion pairs on input capacitance of 30 pF. Discussion is also given for designing a resistance-capacitance-coupled low noise amplifier for grid pulses. Equating the differentiating time constant with integrating time constant gives the condition for minimum attainable noise charge as well as the condition of fairly good linearity between input and output wave forms. Optimum integrating time constants for various grid pulses lie between (0.55 to 1.1) × (collection time of grid pulses). Finally a special linear gate and pulse shape converter for the grid pulses are described. This system converts very slow grid pulses into narrow rectangular wave forms of the same amplitude, thus enabling them to be analyzed by a commercially available biased-discriminator-type twenty channel pulse height analyzer. (auth)

16542 MAGNETIC ANALYSIS OF 42-Mev CYCLOTRON ALPHA PARTICLES. D. K. McDaniels, W. Brandenberg, G. W. Farwell, and D. L. Hendrie (Univ. of Washington, Seattle). Nuclear Instr. & Methods, 14: 263-71(Jan. 1962). (In English)

The performance of the heavy particle magnetic spectrometer built for use in nuclear reaction studies with the University of Washington 60-inch cyclotron is described. The spectrometer is of the single-focusing broad-range type having a first order directional focal surface which allows simultaneous focusing of heavy charged particles within an energy range 0.5 to 1.1 E_0. At the maximum expected operating magnetic flux density of 13 kilogauss, E_0 is approximately 65 Mev for protons or alpha particles. The inherent energy resolution of the spectrometer is found to be better than 0.1%. In experiments using the cyclotron, the principal factors which limit the resolution are actually energy spread in the incident beam, target thickness, finite source size, and kinematic broadening. An over-all resolution of less than 0.30% can be obtained consistently under normal experimental conditions. A detailed experimental study of the kinematic broadening effect for light nuclei verifies the existence of a displaced first order focal surface on which kinematic aberration is absent. For alpha particles scattered by C^{12}, moving the detector to this new focal surface permits an increase of the effective solid angle by a factor of eight for a given value of the energy resolution. (auth)

16543 A 4π PROPORTIONAL COUNTER SUITABLE FOR 4π β-γ COINCIDENCE COUNTING AND ROUTINE USE. R. Withnell (Brookhaven National Lab., Upton, N. Y.). Nuclear Instr. & Methods, 14: 279-80(Jan. 1962). (In English)

A 4π proportional counter is described that is suitable for 4π beta-gamma coincidence counting and routine use. The counter exhibits good plateau and background characteristics and is safe and easy to use. An exploded diagram of the counter showing construction and internal arrangement is presented along with diagrams showing plateau characteristics. (N.W.R.)

16544 HIGH-PRESSURE GAS SCINTILLATION COUNTERS. R. E. Shamu (Univ. of Wisconsin, Madison). Nuclear Instr. & Methods, 14: 297-301(Jan. 1962). (In English)

Two high-pressure gas scintillation counters are described. Properties of gas scintillators which were studied with these counters include the variation of pulse height with pressure and the linearity of pulse height with energy. For purified argon, purified neon, neon-xenon mixtures, and helium-xenon mixtures the pulse height for Po α particles was observed to increase by almost a factor of two as the gas pressure was changed from 8 to 20 atm, then to remain approximately constant from 20 to 40 atm. From 40 to 170 atm the pulse height for a helium-xenon mixture decreased slightly as the gas pressure was increased. The pulse-height linearity for a filling of 42 atm helium and 8 atm xenon was investigated with T(p,n) neutrons. The pulse height corresponding to the maximum-energy helium recoils was found to be directly proportional to energy for the neutron-energy range 0.6 to 9.0 Mev. (auth)

16545 ABSOLUTE BETA COUNTING BY AN END-WINDOWED G. M. COUNTER. P. Brovetto (Istituto di Nazionale di Fisica Nucleare, Turin), E. Chiavassa, G. Rosa, and A. Pasquarelli. Nuclear Instr. & Methods, 14: 302-6(Jan. 1962). (In English)

A formula is given to evaluate the correction for geometry and window effects when a G-M counter is employed to determine the absolute activity of a β emitter. The results were obtained in a geometry close to 2π. Relationship between mass-absorption coefficient and maximum energy of β particles was found experimentally by employing five β sources in the energy range from 0.15 to 2.3 Mev. (auth)

16546 INFLUENCE OF THE PRESENCE OF A PP$^+$ JUNCTION ON THE BEHAVIOR OF A NUCLEAR PARTICLE DETECTOR WITH AN NP JUNCTION. Jean Messier and Jean Valin (Centre d'Études Nucléaires, Saclay, France). Nuclear Instr. & Methods, 14: 307-10(Jan. 1962). (In French)

Silicon npp$^+$ junctions were studied as charged particle detectors with no bias applied. Pulse height and shape analysis show that monoenergetic α particles induce two types of pulses corresponding respectively to the particles entering the detector in the vicinity of the pn and pn$^+$ junctions. This analysis calculates the electrical characteristics of the pn and pp$^+$ junctions and leads to the conclusion that the pp$^+$ junction acts as a mirror for the electron-hole pairs created in the p region. (auth)

16547 COINCIDENCE ANALYZER FOR USE WITH PULSED ACCELERATORS. Hiroshi Taketani (Univ. of Rochester, N. Y.). Nuclear Instr. & Methods, 14: 311-14 (Jan. 1962). (NYO-9750) (In English)

A simple time-to-pulse height conversion technique was used for the determination of true and accidental coincidence rates in a series of (pp′γ) correlation measurements. The pulse from the inelastic proton counter was fed to the start input of a time-to-pulse height converter. The stop signal was produced by the gamma pulses after an appropriate delay. The converter output then yielded a direct measurement of the p′γ coincidence rate over a time interval which could be chosen to include several beam pulses before and after the one giving rise to the inelastic proton. A detailed description of a circuit which has provided stable and reliable operation in this service is presented. (auth)

16548 AN ELECTRONIC PULSE MULTIPLIER FOR APPLICATIONS IN NUCLEAR PHYSICS. J. H. Aitken (National Research Council, Ottawa). Nuclear Instr. & Methods, 14: 343-7(Jan. 1962). (In English)

A relatively simple method is proposed for multiplying together the two voltage pulses corresponding to E and dE/dx for a charged particle and for gating a pulse height analyzer to record only those E pulses whose E dE/dx product is equal to some preselected value. To form the product, the amplitude-to-time conversion in the multichannel analyzer handling the E pulse is further exploited. The time analogue of the E pulse is obtained from the analyzer and is fed to a separate circuit to be combined with the dE/dx pulse to form a pulse whose height is proportional to the product of E and dE/dx. The product pulse is then sorted by a single channel analyzer, in time to allow an inhibiting pulse to be fed back into the multi-channel analyzer if the product pulse is not of the desired value. The inhibiting pulse prevents the E pulse from being recorded in the memory of the analyzer; in the absence of an inhibiting pulse, the E pulse height is recorded in the memory. (auth)

16549 A PULSE RESOLVER USING TUNNEL DIODES. John D. McGervey (Western Reserve Univ., Cleveland). Nuclear Instr. & Methods, 14: 351-2(Jan. 1962). (In English)

A simplified resolving circuit using tunnel diodes is described that is designed to feed slow counting rates into a mechanical register, eliminating the need for a fast scaler. The resolver feeds each count into the register as soon as it is received instead of storing counts until it is filled to capacity. (N.W.R.)

16550 COIL ARRANGEMENT FOR A β-RAY SPECTROMETER WITH CURVED EXIT SLIT. H. Daniel and P. Jahn (Max-Planck-Institut für Kernphysik, Heidelberg). Nuclear Instr. & Methods, 14: 353-4(Jan. 1962). (In English)

A coil system for producing the desired magnetic field of a curved exit slit type beta spectrometer which according to calculations should allow a fairly high transmission at a very high resolution is computed. The desired field distribution within the symmetry plane is shown. In the first step of the computations current loops are assumed, neglecting the finite size of the wire. The second step is to include finite size effects. The coil arrangement and the vacuum chamber are schematically shown and the data of the coils is given. (N.W.R.)

16551 GALLIUM PHOSPHIDE DIODES FOR THE PRODUCTION OF FAST LIGHT PULSES. J. W. Allen and P. E. Gibbons (Services Electronics Research Lab., Baldock, Herts, Eng.). Nuclear Instr. & Methods, 14: 355-6(Jan. 1962). (In English)

The construction and performance of a gallium phosphide diode for fast light pulse sources for testing, timing, and triggering photomultipliers are described. The diode is transparent to green and yellow light. The breakdown voltage is 8 to 10 v with sharp breakdown characteristics. (N.W.R.)

16552 THE USE OF SIMPLE SCINTILLATION ALPHA SPECTROMETRY FOR CONTAMINATION CONTROL IN LABORATORIES. H. J. Gale (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. in Med. Biol., 6: 577-82(Apr. 1962). (AERE-M-931)

Samples of alpha-active contamination arising in laboratories have been analyzed using a scintillation spectrometer with a cesium iodide phosphor. This counter is more rapid in operation than a gridded ion-chamber, and although having inferior resolution enables a quick indication of the probable contaminant to be made. Samples deposited on filter paper can usually be analyzed without pre-treatment and the energy of a single alpha-emitter present can be determined. When more than one energy is present, normally only the highest energy can be measured. As little as 1 picocurie of alpha activity can be assessed. (auth)

16553 EFFECTS OF FINITE PROBE SIZE IN THE DETERMINATION OF ELECTRON ENERGY DISTRIBUTION FUNCTIONS. J. D. Swift (Northern Polytechnic, London). Proc. Phys. Soc. (London), 79: 697-701(Apr. 1, 1962).

The corrections necessary in the measurement, by means of a spherical Langmuir probe, of the energy distribution function $f_0(U)$ of the electrons in a plasma are analyzed. The principal effect considered here is the disturbance of the plasma produced by the drain of electrons to the probe. This disturbance becomes increasingly serious as the gas pressure p and the probe radius a increase and as U decreases. It is shown that the true value of $f_0(U)$ differs by less than 25% from that determined from the simple theory neglecting the disturbance provided $U > \frac{1}{2}\overline{U}$ and $a < \frac{1}{2}l_e$ where l_e is the electron mean free path. (auth)

16554 AN IONIZATION CHAMBER FOR KILOCURIE SOURCE CALIBRATIONS. Victor H. Ritz and Frank H. Attix (Naval Research Lab., Washington, D. C.). Radiation Research, 16: 401-15(Apr. 1962).

A graphite cavity ionization chamber suitable for measuring the exposure dose rate (r/hr) in kilocurie Co^{60} γ-ray sources is described, and the associated techniques involved are discussed in some detail. The chamber has excellent ion saturation properties and can be used to determine the exposure dose rate absolutely to within ±2% at dose rates up to 1×10^7 r/hr. The use of chambers with walls of different atomic number to determine the influence of low-energy scattered radiation on the absorbed dose (rads) in high-z materials is also described. (auth)

16555 CALIBRATION OF THE ABSORBED DOSE PRODUCED IN WATER BY BETATRON ELECTRONS WITH THE BENZOIC-ACID DOSIMETER. Nathaniel F. Barr, Mary B. Stark, and John S. Laughlin (Sloan-Kettering Inst. for Cancer Research, New York). Radiology, 78: 625-9 (Apr. 1962).

The benzoic acid dosimeter was used to determine the absorbed dose rate produced by betatron electrons at the depth of relative maximum dose in water. These measurements were related to the conventional and arbitrary specification of betatron electron exposure in terms of the reading of a Victoreen thimble chamber inserted in a polystyrene block. Chemical yield and Victoreen chamber readings were obtained for all field sizes and energies (6 to 20 Mev) used in therapeutic applications of the betatron electron beam. (C.H.)

16556 JUNCTION DIODE SEMICONDUCTORS FOR X- AND GAMMA-RAY DOSAGE MEASUREMENT. Leonard Stanton and David A. Lightfoot (Hahnemann Medical Coll., Philadelphia). Radiology, 78: 633-4(Apr. 1962).

Gallium arsenide p-n junctions appear to offer most promise for dosimetry in the diagnostic range. While p-n junctions have excellent electrical properties, they exhibit marked energy dependence. This is aggravated in the test units by the use of gallium arsenide (atomic numbers 31 and 33 respectively). Silicon diodes should greatly reduce this effect; also the employment of drifted lithium junctions of deeper depletion regions should increase the sensitivity to gamma rays. (auth)

16557 NANOSECOND COINCIDENCE CIRCUIT USING TUNNEL DIODES. A. Whetstone and S. Kounosu (Univ. of Pennsylvania, Philadelphia). Rev. Sci. Instr., 33: 423-8 (Apr. 1962).

A tunnel diode coincidence circuit which is versatile and simple is described. It is intended to serve as the elemental block for building up complicated fast logic schemes which are frequently required in high energy physics experiments. Performance results are given as well as discussions of numerous possible variations on the design. (auth)

16558 ACOUSTIC THERMOMETRY. Joseph H. Apfel (General Dynamics Corp., San Diego, Calif.). Rev. Sci. Instr., 33: 428-30(Apr. 1962).

A new technique for measuring temperatures by means of the velocity of sound in a gas is described. A closed-end, gas-filled pipe is excited to longitudinal acoustic resonance, and the resonant frequency is measured. The temperature of the gas is then determined from the well-known relations between the temperature and the velocity of sound. The generation and detection of acoustic waves are carried out by a transceiver which is remote from the measuring region and which is connected to the cavity by a small-diameter, gas-filled tube. The technique is particularly well suited to high-temperature studies in nuclear-radiation environments. (auth)

16559 ION SOURCE FOR LOW-ENERGY NEGATIVE IONS. E. E. Muschlitz, Jr., H. D. Randolph, and J. N. Ratti (Univ. of Florida, Gainesville). Rev. Sci. Instr., 33: 445-7(Apr. 1962).

A negative ion source is described which is capable of producing negative ion beams of moderate intensity, but with relatively narrow spread in ion energy. The source consists essentially of a jet of gas intersected by an electron beam. The pressure in the vicinity of the thermionic electron source is kept low by differential pumping. Although ion currents are not as high as those obtained with discharge sources, the present source produces ion beams particularly free of noise and instability. (auth)

16560 BERYLLIUM SAMPLE CELL FOR X-RAY DIFFRACTION STUDY OF LIQUIDS. H. H. Paalman

(Stanford Univ., Calif.) and C. J. Pings. Rev. Sci. Instr., 33: 496-7 (Apr. 1962).

A cylindrical beryllium sample cell used for x-ray diffraction studies of liquids at high pressures is described. The cell was successfully tested with a static pressure of 1000 psi, and extensive x-ray diffraction measurements on a sample of liquid nitrogen confined at 100 psi and −193°C were made. (N.W.R.)

16561 IMPROVEMENTS IN OR RELATING TO SIGNAL RECORDING AND DISPLAY ARRANGEMENTS. William Dennis Cain (to Marconi Instruments Ltd.). British Patent 890,934 Mar. 7, 1962.

A signal recording and display arrangement is designed in which one recorder is used to record a large number of signals and is particularly intended for supervisory use in nuclear power plants. The arrangement comprises means for sequentially deriving signals from a large number of points and means for comparing each derived signal with a reference signal, the results of each comparison being recorded in turn on the recorder. When the derived signal departs from a predetermined relationship with the associated reference signal, the pen will be laterally displaced. Thus, when the supervised equipment is operated correctly, all the recordings will be in a straight line. An embodiment of the arrangement is described for monitoring the gas from different parts of a reactor for radioactivity. (D.L.C.)

16562 SCINTILLOMETER COMPONENT. (to Harshaw Chemical Co.). British Patent 893,505. Apr. 11, 1962.

A scintillometer component comprising a scintillating crystal coupled to a photomultiplier tube is designed so that critically refracted light is redirected to the photocathode by means of a diffuse reflective coating. The coating is preferably dry MgO or Al_2O_3 and covers all uncontacted areas of the crystal and the crystal-adjacent portion of the photomultiplier tube. (D.L.C.)

16563 IMPROVEMENTS IN OR RELATING TO IONISATION CHAMBER CIRCUITS. Raymond John Cox and Donald Harrison (to United Kingdom Atomic Energy Authority). British Patent 893,907. Apr. 18, 1962.

A radiation measuring apparatus is designed which uses an a-c polarizing potential on the ionization chamber. The apparatus comprises, besides the ionization chamber and a source for the a-c polarizing potential, an a-c amplifier for measuring the chamber current, phase-sensitive means for using the in-phase or anti-phase component of the amplifier output as a measure of the radiation flux, and phase-sensitive means for using the quadrature component of the amplifier output to check that the apparatus is functioning properly. (D.L.C.)

16564 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR ASSESSMENT OF FILM BADGES. George Raymond Briscoe Wilson (to United Kingdom Atomic Energy Authority). British Patent 894,613. Apr. 26, 1962.

An apparatus is designed for the automatic assessment of the density of developed films. The apparatus comprises a comparator film with varying density, a holder for the comparator film, means for positioning a developed film, a light source for illuminating both films, circuits sensitive to light passing through the films, means for moving the comparator film holder to equalize the density thereon and that of the developed film, and calibrating means of the holder for indicating the value of film density. Means is also provided for varying the source intensity in accordance with the density of the films. (D.L.C.)

16565 DENSITY MEASURING APPARATUS AND METHOD. Norman Zinkan Alcock and Geoffrey James Leighton (to Canadian Curtiss-Wright Ltd.). British Patent 895,353. May 2, 1962.

A beta ray energy apparatus for measuring the mass per unit area of a material is designed with a wide angle of radiation and masks in order to reduce errors due to motion of material, vibration, material composition, source decay, etc. The apparatus is adapted for the continuous measurement of a moving sheet or of a coating on a moving sheet. (D.L.C.)

16566 PRECIPITATION CHAMBERS. Frank Harlen, Daniel James O'Sullivan, Dennis Ernest Lambeth, and David Gurney Arnold Thomas (to Dowty Electrics Ltd.). U. S. Patent 3,031,573. Apr. 24, 1962.

A precipitation chamber for counting of fission products in gases to detect fuel element failure in gas-cooled reactors is designed for reduction of the time required to replace a broken wire conductor. The chamber and counter unit is adapted for transverse insertion of a wire, and the replacement wire may be in the form of an endless loop ready to be transferred to the operative position. (D.L.C.)

16567 METHOD AND MEANS OF MEASURING RADIATION TRI-DIRECTIONALLY. Lewis H. Gevantman and James F. Pestaner (to U. S. Navy). U. S. Patent 3,031,575. Apr. 24, 1962.

A method is outlined for determining the extent of energy or dose absorbed by a body or object when impinged by radiation. A mold is made of the object and two phantoms with equivalent geometry and tissue equivalent are made with an agar gel containing a chemical system for indicating dose absorption by optical density changes, e.g., potassium iodide or trichloroethylene with a color indicator. One phantom is irradiated and both phantoms are then sliced in planes normal to the direction of the irradiating beam. Optical density readings are made with a microphotometer on corresponding slices of both phantoms and the difference taken as a measure of the dose. (D.L.C.)

16568 RADIATION DETECTOR. David W. Garbellano. U. S. Patent 3,031,577. Apr. 24, 1962.

A portable and simple radiation detector of the gas type is designed for gamma radiation of intensity ranging from a few r/hr to several thousand r/hr. The detector has means for varying the rate of voltage rise for setting a predetermined frequency of pulsed gas conduction in any radiation field; the means is provided with a calibrated scale showing the intensity of the radiation when the discharge frequency is held constant. The gas preferably is Xe, Kr, or Ar. (D.L.C.)

16569 HIGH PRESSURE GAS REGULATOR. Robert W. Ramage (to U. S. Atomic Energy Commission). U. S. Patent 3,033,229. May 8, 1962.

A gas regulator operating on the piston and feedback principle is described. The device is particularly suitable for the delicate regulation of high pressure, i.e., 10,000 psi and above, gas sources, as well as being perfectly adaptable for use on gas supplies as low as 50 psi. The piston is adjustably connected to a needle valve and the movement of the piston regulates the flow of gas from the needle valve. The gas output is obtained from the needle valve. Output pressure is sampled by a piston feedback means which, in turn, regulates the movement of the main piston. When the output is other than the desired value, the feedback system initiates movement of the main piston to allow the output pressure to be corrected or to remain constant. (AEC)

16570 EMISSION SPECTROMETER. Homer Fay, Paul H. Mohr, and Gerhard A. Cook (to Union Carbide Corp.). U. S. Patent 3,032,654. May 1, 1962.

A method and an emission spectrometer are described for the quantitative determination of nitrogen traces in argon in ranges up to 1 vol % nitrogen. The method comprises exciting the mixture with a silent electric discharge and measuring the intensity of a selected nitrogen radiation band in the spectrum produced. The method can be used to analyze a continuous flow of the mixture. (D.L.C.)

16571 RADIATION DETECTORS. Arthur H. Youmans (to Well Surveys, Inc.). U. S. Patent 3,032,658. May 1, 1962.

A radiation detector is designed for detecting gamma rays and neutrons either simultaneously or separately and for making spectral analyses of gammas and neutrons in well logging. The detector comprises an annulus of LiI with a core of NaI or LiI enriched with Li^6 and suitable instrumentation for making the logs. (D.L.C.)

Materials Testing

16572 (ASD-TR-61-74) DEVELOPMENT OF METHODS AND INSTRUMENTS FOR MECHANICAL EVALUATION OF REFRACTORY MATERIALS AT VERY HIGH TEMPERATURES. [Covering Period] May 15, 1960 to May 15, 1961. Delbert H. Fisher, Donald N. Gideon, George M. McClure, and Frank C. Holden (Battelle Memorial Inst., Columbus, Ohio). Apr. 1961. Contract AF33 (616)6155. 66p. (AD-263989)

A system was developed for determining the conventional mechanical properties of materials at temperatures up to 4000°F in vacuum. Techniques for obtaining stress-strain properties in tension and compression are described. Strains are measured optically directly at the gage section to an accuracy of ±50 mu in./in. in a 2-in. gage section. An evaluation of the system was made using a Mo-O.5Ti bar material. Exploratory work was conducted on graphite and a refractory sheet metal. The results of these tests are included. With the objective of developing a temperature source for use above 4000°F, experiments were conducted to produce and to evaluate TaC-coated graphite heaters. Good coatings of TaC were produced both on thin-wall cylindrical heaters and on spiral heaters. It was found that C contamination of the atmosphere occurred such that W shields or W specimens were attacked at temperatures under 5400°F. Possible means of improving carbide coatings are suggested. (auth)

16573 (WAL-TR-142.1/2) RADIOGRAPHY OF URANIUM. Satrak Der Boghosian and Charles E. Dixon (Watertown Arsenal, Mass.). Mar. 1962. 15p.

In the radiography of thick U sections, special projection and filtering techniques were developed to reduce internal scattering. These techniques produced acceptable quality radiographs of sections up to $2\frac{3}{4}$ in. in thickness using 2-mev industrial radiographic equipment. (auth)

16574 (WT-721) TESTS ON THE LOADING OF BUILDING AND EQUIPMENT SHAPES. E. V. Gallagher and T. H. Schiffman (Air Materiel Command, Wright-Patterson AFB, Ohio). July 1955. Project 3.1 [of] Operation UPSHOT-KNOTHOLE. 363p.

Activities are reported in a test program to develop methods of predicting blast loadings on simple structures of military interest. Included are descriptions of each detonation and a compilation of all project results on blast and shock, thermal radiation, nuclear radiation, weapons effects, and a summary of each project. (J.R.D.)

16575 (DC-58-8-38) A METHOD FOR MEASURING THE COEFFICIENT OF THERMAL CONDUCTIVITY OF REFRACTORY MATERIALS AT HIGH TEMPERATURES. V. V. Pustovalov. Compiled by James H. Guill (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Translated from Zavodskaya Lab., 23: 1093-4(1957). 6p.

An apparatus was developed for determining the coefficient of thermal conductivity of ceramics at temperatures up to 1500°C. This apparatus is based on the simplest method involving cylindrically shaped shells which insure sufficient accuracy of measurements and consist of small dimensional components. A carborundum-rod heater was used. The essential characteristic of the apparatus is the extent of heat scattered in the direction away from that of the thermal flux. The lateral thermal losses in most diverse experiments did not exceed 2%. Absolute measurements of the coefficient of thermal conductivity were also conducted. (M.C.G.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

Refer also to abstracts 16043, 16044, 16070, 16074, 16077, 16078, 16079, 16080, 16081, and 16082.

16576 (PNE-129F) MONITORING VIBRATIONS AT U. S. BORAX AND CHEMICAL COMPANY POTASH REFINERY, CARLSBAD, NEW MEXICO. G. J. Hansen and R. G. Oliveira (Sandia Corp., Albuquerque, N. Mex.). Jan. 10, 1962. Contract [AT(29-1)-789]. 18p. Project GNOME.

Ground motion near Carlsbad, New Mexico was measured and recorded. Comparison was made between shot signals, predicted shot signals, and normal refinery background vibrations. In general, the Gnome signals were below predicted levels but well above normal background. No shot damage was apparent anywhere in the refinery. (auth)

16577 (TID-14861(Vols.I and II)) ISOTOPIC GEOCHEMISTRY OF URANIUM AND LEAD AND HELIUM AND ARGON IN ROCKS AND MINERALS. VOL. I. J. Laurence Kulp, E[dward] J. Catanzaro, J. C. Engels, G. P. Erickson, F. P. Fanale, R. Kologrivov, I. G. Swainbank, and J. M. Wampler (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory. Geochemistry Lab.). Includes Appendixes: B. THE HELIUM METHOD AND THE AGE OF THE CORNWALL, PENNSYLVANIA MAGNETITE ORE. F. P. Fanale and J. L[aurence] Kulp. C. ABSOLUTE AGE DETERMINATIONS IN EAST GREENLAND. J. Haller, L. Koch, and J. L[aurence] Kulp. VOL. II. Consists of Appendix A—a thesis: A STUDY OF DISCORDANT ZIRCONS FROM THE LITTLE BELT (MONTANA), BEARTOOTH (MONTANA), AND SANTA CATALINA (ARIZONA) MOUNTAINS. Edward J. Catanzaro. Jan. 15, 1962. Final Report of Contract AT(30-1)-1114 and Annual Progress Report No. 7 of Contract AT(30-1)-1669. 333p.

Research accomplishments are summarized on: zircon dating and the metamorphic history of the basement rocks in the Little Belt Mountains; the effects of thin intrusives at shallow depth on K–Ar ages; isotopic U–Pb ages of zircons from the Beartooth Mountain area; zircon isotopic ages and the metamorphic history of the Catalina Mountain area; development of U–He method of geochronometry; K–Ar dating methods for mafic rocks, mid-atlantic ridge, Pacific basaltic rocks, and ocean floor basalts; metamorphic history of the southern Appalachians; Norwegian basement rocks; isotopic composition of lead in sedimentary minerals; age of the basement rocks underlying Kansas; K–Ar ages on rocks from the Cascade Range; lead isotopes in lead ores; and geologic history and K–Ar ages of rocks from eastern Greenland. (B.O.G.)

16578 SOLID STATE FORMATION OF BARIUM, STRONTIUM AND LEAD FELDSPARS IN CLAY-SULFATE MIXTURES. C. A. Sorrell (Miami Univ., Oxford, Ohio). Am. Mineralogist, 47: 291-309(Mar.-Apr. 1962).

Mixtures of kaolin-type clays and sulfates with theoretical compositions of the barium, strontium, and lead feldspars were x rayed continuously during heating to 1400°C at a rate of 5°C per minute. Formation of the feldspars in the solid state is characterized by the appearance of a metastable phase with a structure similar to hexagonal celsian and hexagonal anorthite. The barium hexagonal phase is very persistent. Prolonged heating is necessary to convert it completely to the feldspar, the conversion proceeding more rapidly with increasing temperature. The strontium and lead hexagonal phases are, however, very unstable, having been detected only during continuous x-ray investigation. They also change to the feldspars, the change occurring more rapidly with increasing temperature. The presence of small amounts of impurities has a marked effect on the formation temperatures and reaction rates. Titania tends to lower formation temperatures of the reaction products and to enhance the x-ray diffraction maxima. Potash tends to inhibit formation of the hexagonal phases and to promote formation of the feldspars in the barium and strontium compositions but has little effect on the lead phases. (auth)

16579 THE PRESSURE PULSE PRODUCED BY A LARGE EXPLOSION IN THE ATMOSPHERE. PART II. V. H. Weston (Univ. of Michigan, Ann Arbor). Can. J. Phys., 40: 431-45(Apr. 1962).

The pressure pulse produced by a large explosion in the atmosphere is investigated. A realistic model for the vertical temperature is taken, with two temperature ducts and the large temperature gradient in the thermosphere. The first three dominant modes or "free waves" are computed for the low-frequency range. The contribution of these modes to the head of the pressure pulse produced by a large explosion is calculated for a particular range. It is shown that the "high-frequency" phenomena previously observed is a superposition of relatively low-frequency modes. An increase in the altitude of the source produces a corresponding decrease in relative intensity of the higher order modes, so that for an intense explosion at high altitudes, the low-frequency gravity wave mode is dominant. (auth)

16580 GRAVITY AND ACOUSTICAL WAVES. V. H. Weston (Univ. of Michigan, Ann Arbor). Can. J. Phys., 40: 446-53(Apr. 1962).

The spectrum of the gravity and acoustical waves are discussed for two types of models of the atmosphere. Emphasis is placed upon the discrete set of modes important in the propagation of energy, long distances around the earth, from large explosions in the atmosphere. (auth)

16581 MASS SPECTROMETER MEASUREMENTS IN THE THERMAL AREAS OF NEW ZEALAND. PART 1. CARBON DIOXIDE AND RESIDUAL GAS ANALYSES. J. R. Hulston and W. J. McCabe (Dept. of Scientific and Industrial Research, Lower Hutt, N. Z.). Geochim. et Cosmochim. Acta, 26: 383-97(Mar. 1962). (In English)

Mass spectrometer measurements were made on carbon dioxide and residual gases in some thirty geothermal bores, fumaroles, and pools in New Zealand. With one exception, the Ar^{40}/Ar^{36} ratio in the discharges show the argon to be of atmospheric origin. Consideration of argon to water ratios appears to confirm the hypothesis that loss of gas occurs underground in some areas. The argon to nitrogen ratios which were lower than the 2.7/100 value expected from heated ground water, suggest an alternative source of nitrogen. The excess nitrogen appears to be related to the total hydrogen content by a square law. The underground temperatures calculated assuming chemical equilibrium between carbon dioxide and methane are given in some cases and are in reasonable agreement with bore measurements. (auth)

16582 MASS SPECTROMETER MEASUREMENTS IN THE THERMAL AREAS OF NEW ZEALAND. PART 2. CARBON ISOTOPIC RATIOS. J. R. Hulston and W. J.

McCabe (Dept. of Scientific and Industrial Research, Lower Hutt, N. Z.). Geochim. et Cosmochim. Acta, 26: 399-410 (Mar. 1962). (In English)

Variation of the C^{13}/C^{12} ratio of gas and water samples from pools, bores, and fumaroles of the North Island of New Zealand were studied. Calculations of isotopic equilibrium temperatures from the δC^{13} values of methane and carbon dioxide were made and indicate temperatures of 350 and 440°C on Big Donald Mound, White Island; of approximately 250°C from bores in the Wairakei area and 280°C from Champagne Pool at Waiotapu. These latter results are in good agreement with measured bore temperatures at depth. (auth)

16583 GEOCHRONOLOGICAL STUDIES OF DEEP SEA SEDIMENTS BY THE IONIUM/THORIUM METHOD. Edward D. Goldberg and Minoru Koide (Univ. of California, La Jolla). Geochim. et Cosmochim. Acta, 26: 417-50 (Mar. 1962).

The ionium/thorium method for determining the rates of accumulation of marine sediments was applied to a group of deposits from the Pacific, Atlantic, and Indian Oceans. The thorium isotopes which were accommodated in authigenic minerals (presumably derived from sea water) were obtained through a hot hydrochloric acid leaching of the sample. A model for the mixing of the upper layers of the sediment, by worm-burrowing or near-bottom currents, is proposed and, if valid, allows the depth of mixing to be ascertained from the ionium/thorium profiles. Sediments in the South Pacific had rather uniform and low rates of deposition (0.3 to 0.6 mm/10^3 years), while the North Pacific values in general were at least several times higher. These results are in accord with a much greater contribution of sedimentary components from the continents in the northern area. South Atlantic depositional rates were of the same order, millimeters per thousand years, as the North Pacific, while two adjacent Indian Ocean cores gave widely contrasting values. Surface values of the ionium/thorium ratio, and to a lesser extent the hydrochloric acid leachable thorium concentrations, showed a marked geographical dependence which was attributed to the relative amounts of continental run-off an oceanic area receives. (auth)

16584 THE TRANSPORT OF TRACE SUBSTANCES IN THE ATMOSPHERE AND THEIR IMPLICATIONS FOR THE GENERAL CIRCULATION OF THE STRATOSPHERE. Reginald E. Newell (Massachusetts Inst. of Tech., Cambridge). Geofis. pura e appl., 49: 137-58(1961 II). (In English)

Considerations concerning the distribution of artificial radioactive substances in the troposphere point to the occurrence of stratospheric-tropospheric exchange in the region of the discontinuity between the tropical and middle latitude tropopause. Computations of the horizontal flux of ozone in the lower stratosphere and examination of the distribution of the tracer tungsten-185 in the stratosphere suggest that the trace substances are transported northwards from the tropical stratosphere by the action of transient eddy processes in which northward moving parcels of air are sinking and southward moving parcels are rising. The amount of ozone transported varies seasonally and is a maximum in the late winter and spring. The total transport appears sufficient to account for the observed spring build-up of ozone in middle and high latitudes. The eddies invoked are shown to be consistent with the observed counter-gradient transport of heat in the lower stratosphere, the pattern of stratospheric isentropes and the covariance values found from meridional and vertical velocities. The combined results indicate a new view concerning the mechanics of stratospheric motions as contrasted with the classical ideas of mean meridional motions. (auth)

16585 COSMIC RAY PRODUCED RADIOISOTOPES FOR STUDYING THE GENERAL CIRCULATION IN THE ATMOSPHERE. D. Lal (Tata Inst. of Fundamental Research, Bombay). Indian J. Meteorol. Geophys., 10: 147-54(Apr. 1959).

The possibility of using cosmic–ray–produced radioisotopes for studying large scale circulation in the atmosphere is explored. Radioisotopes are observed whose half lives are comparable to time scales involved in the atmospheric circulation. Four of the isotopes (S^{35}, Be^7, P^{33}, and P^{32}) have half life periods ranging from two weeks to three months, and one (Na^{22}) has a half life of about two and a half years. Isotope production is continuous, constant, strongly dependent on the latitude and altitude in the atmosphere, and independent of meteorological factors. These isotopes can be used for investigating the nature of circulation of air in the troposphere and the detailed mechanism of exchange of air between the stratosphere and the troposphere. Experimental work on determination of the concentration of these isotopes in rain water is summarized. (auth)

16586 A GENERAL METHOD FOR SAND LABELLING WITH RADIOACTIVE NUCLIDES. A. Gibert and S. Cordeiro (Ministerio das Obras Publicas, Laboratorio Nacional de Engenharia Civil, Lisbon). Intern. J. Appl. Radiation and Isotopes, 13: 41-5(Jan. 1962). (In English)

This work is a contribution to the study of the movements of the sea sand, by means of direct labelling of sand with a glue containing radioactive tracers. The method was successfully employed in the study of the movement of sand by the seaside, near Povoa do Varzim, a port in the north of Portugal by labelling a ton of sand with four curies of phosphorus-32. (auth)

16587 COSMIC-RAY PRODUCED RADIOACTIVE ISOTOPES AS TRACERS FOR STUDYING LARGE-SCALE ATMOSPHERIC CIRCULATION. B. Peters (Tata Inst. of Fundamental Research, Bombay). J. Atmospheric and Terrest. Phys., 13: 351-70(1959).

In the interval between two consecutive condensations of moisture, atmospheric air accumulates radioactive isotopes produced by cosmic particles in collisions with nitrogen, oxygen, and argon. The production rates of these isotopes depends strongly on altitude and latitude; the rate of removal depends, between rains, essentially on the half life of each isotope. These facts can be used to label air masses and to trace their trajectories. The isotopes that seem to be most useful for meteorological investigations are P^{32} (half life 14 days), P^{33} (25 days), Be^7(53 days), and S^{35} (87 days). Their concentrations are studied in rains in India during 1956 and 1957, and approximate values are obtained for the annual fall-out. These experimental fall-out values are compared with values calculated from the expected isotope production by cosmic radiation in various parts of the atmosphere. The fall-out based on the annual production of Be^7 agrees well with the measured annual fall-out. The measured fall-out of P^{32} is somewhat higher and that of P^{33} and S^{35} between two and five times higher than the calculated values. The discrepancy is probably significant, although the fall-out data are not very accurate; it is presumably due to an underestimate of the contribution that neutrons with energy below ~40 Mev make to the number of nuclear disintegrations in argon. The data indicate that condensation of water vapor removes cosmic-ray induced radioactivity from the air very efficiently. It can therefore be concluded that different isotopes appear in rain water in the same proportion in which they existed in the air before the moisture was removed. Stratosphere air differs markedly from air that remains in the troposphere throughout the period between successive condensations and precipitations; apart from the fact that its level of activity will in general be higher, it contains a much larger proportion of long-lived compared to short-lived isotopes. Air that descends from the stratosphere and moves into lower regions remains clearly distinguishable for very long periods, until it has been strongly diluted or cleansed by condensation. The simultaneous determination of radioactivity due to two or more isotopes in an individual rain leads, therefore, to information on the past history of the air mass from which the water was condensed. A detailed analysis of twenty-one rain samples from various parts of India, taken between July and December 1957, shows that none of the air masses has characteristics of air that had descended from the stratosphere. (auth)

16588 THE MEASUREMENT OF SAND TRANSPORT BY MEANS OF RADIOACTIVE TRACERS. M. J. Crickmore and G. H. Lean (Dept. of Scientific and Industrial Research, Wallingford, Berks, Eng.). Proc. Roy. Soc. (London), A266: 402-21(Mar. 20, 1962).

Experiments on the development of a method for measuring the sand transport in rivers by means of radioactive tracers are described. In the method, the mean velocity is determined from the rate of displacement of the centroid of a marked cloud of fluid. The spread of radioactive sand was measured from a transverse strip of the bed of a flume in which a steady flow of water and sand is maintained. The distribution of active grains differs from that of a cloud of fluid, however, in that the time scale of the motion is longer due to the slower drift velocity of the particles. Also the particles at low levels in the ripples are at rest for a very much longer time than those in the upper levels so that the spread of the sand particles is much larger than is the case for fluid flow of the same mean velocity and depth. If the motion were allowed to continue for a sufficiently long time it is probable that the distribution would become normal and centered about a point moving with the centroid, but the time for such development would be impracticably long and the transport rate must be deduced from the distributions in the early stages of the motion when the dilution is not very great. In this stage an attempt was made to explain the shape of the distribution curves in terms of a simple model of the mechanism of transport in which it was assumed that every particle has an equal chance of moving a certain hop length. While the distributions given by such a model have a general resemblance to those obtained, the similarity is not quantitatively affirmed. A more complicated model which takes into account both the statistical variation of the hop length of the particles and the times that particles spend at different levels in the ripples appears to be necessary. The experiments showed that the transport rate can be deduced from the mass distribution of tracer particles initially laid to a depth sufficient to cover all levels of movement of the bed ripples, or by measuring the velocity of the centroid of the activity distribution together with an independent measurement of the ripple movements at a point. (auth)

16589 STUDY OF COSMIC RAY PRODUCED SHORT-LIVED P^{32}, P^{33}, Be^{7}, AND S^{35} IN TROPICAL LATITUDES. P. S. Goel, N. Narasappaya, C. Prabhakara, Rama Thor, and P. K. Zutshi (Tata Inst. of Fundamental Research, Bombay). Tellus, 11: No. 1, 91-100(1959).

The fall-out rate of the four short-lived isotopes P^{32}, P^{33}, Be^{7}, and S^{35}, produced in the collisions of cosmic ray particles with air nuclei, is measured at a number of stations in India and compared with the calculated rate of production. In the case of Be^{7}, the agreement between the calculated and measured values is good. The fall-out rates of P^{32} and P^{33} are not inconsistent with the calculated values; that of S^{35}, however, is about five times higher than expected. The absolute concentrations of an individual isotope in various rainfalls are found to vary by more than a factor of forty; relative concentrations of the different isotopes, however, stay within fairly narrow limits. The ratio of the concentration of Be^{7} to that of P^{32} in individual rain samples is used to determine the periods for which various air masses are irradiated in the interval between two successive precipitations. The mean period of irradiation is found to be about thirty-five days. The results are consistent with the view that, in these tropical latitudes, intrusions of stratospheric air into the troposphere are either rare or weak in intensity. (auth)

16590 PROFILING OF FLUID INJECTION WELLS. Millage M. White (to Jersey Production Research Co.). U. S. Patent 3,032,653. May 1, 1962.

An improved method and apparatus are described for determining the injectivity profile of a fluid injection well. The method is based on the principle of two fluid streams being pumped into the well, one through a tube to the bottom of the well and the other into the annular space between the tube and the well wall, but instead of a radioactive fluid being used, a cage with a radioactive ball is suspended adjacent to the lower portion of the tube in the well. In operation, the ball is blown to the point of zero velocity or the interface, and the interface position is determined by a detector in the tube. (D.L.C.)

HEALTH AND SAFETY

Refer also to abstracts 16042 and 16188.

16591 (AD-264822) RADIOLOGICAL DECONTAMINATION OF FOOD AND WATER IN NUCLEAR WAR. Management of Mass Casualties Publication No. 593. Thomas R. Ostrom (Walter Reed Army Medical Center. Inst. of Research, Washington, D. C.). Sept. 1960. 9p.

With existing supplies it is possible to provide food and water for military and civilian populations after a nuclear attack. There are extant methods for decontaminating water, livestock, and packaged foodstuffs. The population must be educated to waste nothing. (auth)

16592 (AEET/HP/SM-4) RADIATION HAZARDS IN URANIUM MINES. P. R. Kamath (India. Atomic Energy Establishment, Trombay). Dec. 1, 1958. 35p.

There is no conclusive evidence that lung cancer among uranium miners is wholly due to radioactivity, although most investigators believe that radon and its daughters are the causative agents. Health hazards involved are essentially inhalation hazards—the exposure to external radiation being not very significant. Except in abnormal cases of radon contamination, which are infrequent, ventilation requirements used in non-uranium mines to prevent silicosis are generally found satisfactory to control airborne radiation hazard. A routine health physics survey is necessary to study the environmental conditions at the working site. A brief outline of such a survey is included. (auth)

16593 (AEET/HP/SM-5) HANDLING HAZARDS OF NATURAL THORIUM. T. N. Viswanathan Pi [l]lai, P. R. Kamath, and S. Somasundaram (India. Atomic Energy Establishment, Trombay). Jan. 1, 1959. 33p.

Data on the handling hazards of natural thorium are summarized. The external and internal hazards of its radiotoxicity are described. The chemical toxicity and pyrophoric and explosive characteristics of thorium and thorium hydride dusts are discussed. The following control measures are outlined: film badge usage, area monitoring, air monitoring, protective clothing, general house-keeping and hygiene, decontamination, bioassay tests, medical care, waste disposal, transportation of thorium concentrates and wastes, fire protection, and education and training of workers. (M.C.G.)

16594 (AEEW-R-138) THE ASSESSMENT OF IODINE-IN-MILK LEVELS IN BULK MILK SUPPLIES FOLLOWING A REACTOR ACCIDENT. R. E. Davis (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Oct. 1961. 19p.

The suitability of some readily available, portable, beta-gamma measuring instruments has been assessed for field use in monitoring bulk supplies of milk, contained in standard 10 gallon cans, contaminated with I^{131} in the range 400 μμc/liter to 325 mμc/liter. The Jefferson probe scintillation detector, employing a 1.5-inch diameter by 1-inch thick sodium iodide crystal, used in conjunction with a 1320c rate-meter was shown to be the most satisfactory. Air hazard and decontamination problems were also evaluated. (auth)

16595 (AHSB(S) R-35) ESTIMATION OF ACCIDENT PROBABILITY DUE TO PROTECTIVE SYSTEM FAILURE IN POWER REACTORS. M. J. Cowper and D. Wray (United Kingdom Atomic Energy Authority. Authority Health and Safety Branch, Risley, Lancs, England). Dec. 13, 1961. 28p.

The probability of failure of any protective system can be reduced to an acceptable level by the application of redundancy combined with a suitable periodicity of proof testing. The failure probability of each part of typical protective systems is estimated in terms of the equipment failure rate, the periodicity of proof testing, the protective logic adopted and the frequency with which the incidents arise. In particular the effect on this probability of using a multi-group detection system to measure fuel can temperature is evaluated for the more commonly used arrangements. Although spurious tripping has no direct bearing on safety, any protective system must be a balance between the ideals of safety and the economic limitations it imposes. The spurious tripping rate of a typical protective system is also estimated for evaluation of maintenance shorting plug use. (auth)

16596 (CDRP-182-101) IRREGULARITIES IN LOCAL FALLOUT DEPOSITION PATTERNS. David C. Kleinecke and Myron B. Hawkins (California. Univ., Berkeley. Inst. of Engineering Research). Dec. 15, 1961. Contract CD-SR-58-40. 23p.

The possibility of irregularities in the distribution patterns of local fall-out from megaton detonations in the United States was investigated briefly. Historical measurements taken at weapons tests in the Nevada and Pacific Proving Grounds were evaluated in terms of the theoretical causes of irregularities and the predicted distribution patterns generated by various fall-out models. The general conclusions were that the present state of knowledge of the details of fall-out distributions is grossly inadequate, and the traditional cigar-shaped patterns are undoubtedly inadequate for describing fall-out patterns from nuclear attack. (auth)

16597 (CEA-2113) MATERIEL D'INTERVENTION EN CAS D'ACCIDENT RADIOACTIF GRAVE. (Safety Apparatus for Serious Radioactive Accidents). R. Estournel and J. Rodier (France. Commissariat à l'Énergie Atomique. Centre de Production de Plutonium de Marcoule, Chusclan). 1962. 27p.

In the case of a serious radioactive accident, radioactive dust and gases may be released into the atmosphere. It is therefore necessary to be able to evaluate rapidly the importance of the risk to the surrounding population, and to be able to ensure, even in the event of an evacuation of the Centre, the continuation of the radioactivity analyses and the decontamination of the personnel. For this, the Anti-radiation Protection Service at Marcoule has organized mobile detection teams and designed a mobile laboratory and a mobile shower-unit. The duty of the mobile teams is described. A description of the apparatus which would be used at the Marcoule Centre in the case of a serious radioactive accident is given. The method of using this apparatus is discussed. (auth)

16598 (CNHW(RP-4)) ANNUAL REPORT FOR 1960 ON THE RADIOACTIVE FALLOUT STUDY PROGRAM. P. M. Bird, A. H. Booth, and P. G. Mar (Canada. Dept. of National Health and Welfare. Radiation Protection Div., Ottawa). Dec. 1961. 56p.

Tabulations are presented of analytical data from measurements of the total β activity of fall-out particles in the air and in precipitation at a number of sampling stations in

Canada. Results are also included of measurements of Sr^{90} in milk powder and in a number of human bone specimens. In general, fall-out levels in Canada during 1960 showed a gradual decline from peak values in 1959. (C.H.)

16599 (CVNA-90(Pt.B, Vol.I)) FINAL HAZARDS SUMMARY REPORT. PART B. LICENSE APPLICATION. VOLUME I. (Carolinas Virginia Nuclear Power Associates, Inc., Columbia, S. C.). Oct. 12, 1961. 84p.

A description of the CVNA reactor site at Parr, S. C., is presented. The surrounding areas are also described. (J.R.D.)

16600 (CVNA-90(Pt.B, Vol.II)) FINAL HAZARDS SUMMARY REPORT. PART B. LICENSE APPLICATION. VOLUME II. (Carolinas Virginia Nuclear Power Associates, Inc., Columbia, S. C.). Jan. 11, 1962. 422p.

A description of the CVNA reactor and nuclear plant are presented. Changes which occurred after publication of the original summary report (CVNA-27) are summarized. (J.R.D.)

16601 (CVNA-90(Pt.B, Vol.III)) FINAL HAZARDS SUMMARY REPORT. PART B. LICENSE APPLICATION. VOLUME III. (Carolinas Virginia Nuclear Power Associates, Inc., Columbia, S. C.). Jan. 12, 1962. 77p.

An analysis of the possible accidents and hazards associated with the CVNA reactor is presented. The analysis is based on a power level of 64.9 Mw. Changes since publication of the preliminary summary are noted. (J.R.D.)

16602 (CVNA-90(Pt.B, Vol.IV)) FINAL HAZARDS SUMMARY REPORT. PART B. LICENSE APPLICATION. VOLUME IV. (Carolinas Virginia Nuclear Power Associates, Inc., Columbia, S. C.). Jan. 12, 1962. 85p.

Basic policies on operation of the CVNA reactor facility are described. Information is included on organization, pre-operational tests and startup instructions, emergency instructions, maintenance instructions, and radiation protection. (J.R.D.)

16603 (ERDL-1671-TR) WATER DEMINERALIZATION AND DECONTAMINATION STUDIES UTILIZING ELECTRODIALYSIS. Paul E. DesRosiers, Jr. (Engineer Research and Development Labs., Fort Belvoir, Va.). May 9, 1961. 73p. (AD-265061)

Laboratory and field tests were made of an electrodialysis process for removal of ionized salts from brackish waters. Laboratory tests were conducted to determine suitability of operational features to military usage; performance characteristics of process; effect of changes in temperature, pH, and feed salinity on performance; and factors reducing effectiveness of the ion-selective membranes. Tests were also conducted to determine the behavior of the demineralizer in the field when removing dissolved mineral matter from brackish well water and to determine the capability of the unit for removal of soluble radioactivity from water. (auth)

16604 (GA-1100(Suppl.3)) SAFEGUARDS REPORT FOR THE EBOR CRITICAL EXPERIMENT. W. B. Wright (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Feb. 15, 1962. Contract AT(04-3)-187. 22p.

Included in the supplement is a description of the concrete building erected around the Experimental Beryllium Oxide Reactor subsequent to issuances of supplements 1 and 2. Other changes described include those in relay circuitry and operational procedures. (J.R.D.)

16605 (GAT-R-281) HEALTH AND SAFETY ACTIVITIES REPORT FOR 1961. (Goodyear Atomic Corp., Portsmouth, Ohio). Mar. 30, 1962. Contract AT(33-2)-1. 58p.

Most of the responsibilities for the health and safety activities at Goodyear Atomic Corporation are distributed among several specialized groups in the Industrial Relations Division. These groups are responsible to the Medical Subdivision and the Safety and Fire Protection Engineering Subdivision. Some of the functions of these groups are characteristic of the atomic energy gaseous diffusion operations and are required by the Atomic Energy Commission. Other functions are similar to those found in most large industrial organizations. The more significant functions of these groups are listed. The statistics compiled during calendar year 1961 are included. The success or failure of any Health and Safety Program is the degree to which undesirable health incidents, property losses, and accidents are limited. The frequency rate of 0.00 during 1961 reflects the best frequency rate accrued by Goodyear Atomic Corporation during its entire operating experience. The severity rate of 71 for the same period compares very favorably with the severity rate during 1960. These rates are well below the average of the Chemical Industry and the Atomic Energy Commission's operations. The plant motor vehicle accident frequency rate was 0.25 in comparison with a rate of 0.81 for 1960. Property damage in 1961 amounted to $4,565.00 as compared with $9,418.00 in 1960. Functions performed by the health and safety groups include: medical examinations; fitting of safety glasses; urinalyses; noise level surveys; equipment inspections; accident investigations; fire protection equipment repair, test maintenance, and inspection; fire protection and fire prevention investigations and training; radiation control; etc. Many of these services are performed on a routine schedule while others are scheduled as needed. The results of plantwide safety performance attest that all of these functions are economically justifiable. (auth)

16606 (HASL-121) PRELIMINARY DATA ON FALL-OUT FROM THE FALL 1961 USSR TEST SERIES. (New York Operations Office. Health and Safety Lab., AEC). Feb. 27, 1962. 7p.

Following the USSR announcement of its intention to resume testing, arrangements were made for the three stations collecting individual rainfall samples to begin analyses for short-lived nuclides. Some of the data obtained are presented. (M.C.G.)

16607 (NDL-TR-24) COLD WEATHER DECONTAMINATION STUDY—McCOY I. Joseph C. Maloney and John L. Meredith (Army Chemical Corps Nuclear Defense Lab., Army Chemical Center, Md.). Jan. 1962. 74p.

The objective of this work was to obtain data on the efficiency of decontamination techniques under below-freezing conditions when applied to outdoor surfaces. Fallout simulant was prepared by tagging 150 to 300 μ sand with lanthanum-140. The simulant was then dispersed onto snow, frozen soil, and roof surfaces. The techniques of fire hosing, snow plowing, and power sweeping were tested. The experimental effort was limited by improper weather conditions. (auth)

16608 (PNE-127P) PRE-SHOT AND POST-SHOT STRUCTURE SURVEY. Preliminary Report. (Holmes and Narver, Inc., Los Angeles). Feb. 1962. Contract [AT(29-2)-20]. 7p. Project GNOME.

The pre-event and post-event condition of all existing surface facilities within a 10-mile radius of ground zero was documented. Except for small cracks in a cement-block foundation and one $^1/_4$-in. crack in a concrete wall at two of the installations, no damage was observed. (M.C.G.)

16609 (PWAC-153) HAZARDS SUMMARY REPORT ON HIGH FLUX TEST REACTOR FOR CANEL. (Pratt and

Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). [July 1956?]. Contract [AT(11-1)-229]. 153p. (PWL-610-11-40A)

A hazards summary is presented for a 45-Mw high-flux test reactor for CANEL. Mechanical design, reactor building, reactor physics, process design, and operational procedures are discussed. The following typical experiments are outlined: circulating fuel in-pile loop, NaK-cooled fuel element in-pile test loop, and aircraft reactor control rod in-pile test. Accidents due to human error, failure of reactor components, failure of experimental apparatus, the maximum catastrophe, and make-up and hazards to the surrounding area are described. (M.C.G.)

16610 (TID-15422) RESEARCH ON THE HAZARDS ASSOCIATED WITH THE USE OF LIQUID HYDROGEN IN BUBBLE CHAMBERS. Progress Report No. 1, March 13–July 31, 1961. M. G. Zabetakis, A. L. Furno, H. E. Perlee, and G. H. Martindill (Bureau of Mines. Explosives Research Lab., Pittsburgh). 19p.

Progress is reported on development of criteria for vacuum tanks. Modification of a 346-liter explosion chamber for use in window failure experiments was completed. Other window-failure equipment was developed. In other work, tests concerned with venting system development and blockhouse spillage tests for hydrogen concentration buildup data and for ignition information were conducted. (J.R.D.)

16611 (USNRDL-TR-549) DECONTAMINATION OF SHIPS' SURFACES. II. DESIGN AND CONSTRUCTION OF EXPERIMENTAL FACILITIES. R. N. Anderson and R. M. Railey (Naval Radiological Defense Lab., San Francisco). Jan. 30, 1962. 32p.

A laboratory study of the fallout from a seawater nuclear detonation and its contamination of ships' surfaces requires special equipment to make the radioactive simulant, to generate and disperse the simulant on painted surfaces, and to decontaminate these surfaces by liquid methods. The simulant is produced by evaporating 30 gal of seawater containing approximately 2 curies of a selected gamma-emitting radionuclide to a final volume of 3 gal. The concentrated solution is fed to a spinning disc generator which produces 200-μ diameter drops at flow rates from 0.06 to 2.5 ml/sec. The drops are generated at the top of a polyethylene-lined chamber 36 ft high, and, as they settle at terminal velocity, they are distributed by a rotating cluster of fans to uniformly deposit on plates 8.5 in. square. The plates are painted with Navy paints and cover a floor area of 1256 ft^2. The contaminated plates are counted, washed, and recounted at the rate of 50/hr in a machine which simulates firehosing and steam cleaning. The effects of solution temperature, spray pressure, spray time and chemical additives in the liquid decontamination methods may thus be evaluated. (auth)

16612 (JPRS-12823) NEW SANITARY REGULATIONS OF WORK WITH RADIOACTIVE SUBSTANCES AND SOURCES OF IONIZING RADIATIONS NO. 333-60 AND "REGULATIONS OF TRANSPORTATION OF RADIOACTIVE SUBSTANCES" NO. 349-60. P. I. Moiseitsev (Moiseytsev). Translated from Gigiena i Sanit., 26: No. 10, 50-7(Oct. 1961). 12p.

The contents of the "Sanitary Regulations of Work with Radioactive Substances and Sources of Ionizing Radiations" No. 333-60 are described. The maximum permissible level and concentration differences between these regulations and international recommendations are given. Radioactive substances and laboratories for handling them are classified according to the activity. The contents of "Regulations on the Transportation of Radioactive Substances" No. 349-60 are also described. Temporary storage of the shipped material and return of empty containers are considered. (D.L.C.)

16613 CRITICAL COMMENTS ON THE DIRECT CONTINUOUS MEASUREMENT OF RADIOACTIVITY IN WATER AND SEWAGE. K. Haberer (Technische Hochschule, Karlsruhe, Ger.). Kerntechnik, 4: 110-15(Mar. 1962). (In German)

Various devices for direct continuous measurement of radioactivity in water are briefly discussed. For purpose of comparison formulas of sensitivity were developed. These formulas comprise variables responsible for the sensitivity towards beta-emitters of different energies, such as surface, geometry, background, thickness of window, and—if required—of water layer. The formulas are based on a common relative error of ±30% with confidence limits at the 95% level. By means of the sensitivity curves obtained by substituting published data into the derived formulas the applicability of the devices is discussed. (auth)

16614 THE MEASUREMENT OF ENVIRONMENTAL RADIATION WITH PLASTIC SCINTILLATORS. A. Wensel and G. Hasl (Universität, Frankfurt am Main). Kerntechnik, 4: 118-19(Mar. 1962). (In German)

The use of plastic scintillation counters for dose rate measurements was studied. The relative response (pulse rate/dose rate) was calculated for various scintillator thicknesses. The curves show a marked energy dependence, which is higher for thick crystals than for thin ones. Measurements were made with a 15.5 cm plastic scintillator with 4 sources of various energies (0.4 to 2.7 Mev). The results are in agreement with the calculated response. (auth)

16615 CALIBRATION OF FAST NEUTRON FILM BADGES. P. Amadesi, A. Cavallini, and O. Rimondi (CNEN, Bologna and Università, Bologna). Minerva nucleare, 5: 323-36(Dec. 1961). (In Italian)

After the introduction of fast neutron detection with nuclear emulsions and the description of a film-badge for personnel dosimetry of neutrons, the method used for the calibration is illustrated. The work consists of an evaluation of the doses and relative standard deviation. The smallest dose that can be revealed is 15 mRem and the highest is 15 rem. The standard deviation changes from a minimum of about 15% for the highest dose, to a maximum of about 27% for the smallest one. A 100 mc RaD–Be source is used for the calibration. The neutron flux is known with a standard deviation of 15%. A graph was drawn up to determine the per cent standard deviation corresponding to the number of the traces scanned. This graph is useful for microscopists during the scanning of the emulsions. Other possible causes of errors were evaluated: influence of fading and of the neutron incidence angle, and fog due to the gamma radiation. From these results it is possible to determine the correction coefficients and improve the precision on the dose measured. (auth)

16616 ESTIMATING HAND EXPOSURE TIME. D. C. Bowden and C. M. Thomas (General Electric Co., [Richland, Wash.]). Nuclear Eng., 7: 152-3(Apr. 1962).

A motion picture analysis is made of the hand exposure time of glove box work. The results show that significant exposure occurs only during a small portion of the total work. (N.W.R.)

16617 QUELQUES PROBLEMS BIOLOGIQUES DE LA RADIOACTIVE ALIMENTAIRE. (Some Biological Problems of the Radioactivity of Food). Georges Cuvier. Les

Conférences du Palais de la Découverte, Serie A, No. 259. Paris, Université de Paris, 1960. 31p.

An outline is given of the physiological effects of micro- and macroscopic quantities of natural and artificial radioactivity. The sources, detection, and properties of radiations are summarized, and the natural cycles undergone by radioisotopes are discussed. The problems of radioactivity in food are examined, using wine, grapes, and milk as examples. (T.F.H.)

16618 THE VINČA DOSIMETRY EXPERIMENT. Technical Reports Series No. 6. (International Atomic Energy Agency, Vienna). 1962. 64p. (STI/DOC/10/6). $1.00(IAEA)

A dosimetry experiment is described which was conducted to simulate a radiation incident involving a brief uncontrolled run of a zero-power reactor. The incident resulted in heavy exposure of six persons to a neutron-gamma mixture. Phantoms were set up at the positions previously occupied by the operating personnel and dosages were determined. (J.R.D.)

16619 RADIOLOGICAL HEALTH DATA QUARTERLY REPORT. VOLUME III, NUMBER 1. (Public Health Service, Washington, D. C.). Jan. 1962. 36p. $0.50 (GPO). (A/AC.82/G/L.743)

Data on environmental radiation levels are presented. Topics covered include: the radiation-surveillance network; surface-air radon, thorium, and fission-product gross beta concentrations at Cincinnati, Ohio; radioactivity measurements in surface air; national air-sampling network; Sr^{90} in U. S. wheat harvested in 1960; Sr^{90} in various types of grains in 1959 and 1960; residual radioactivity in Canadian foods; milk-monitoring program; national water-quality network; external gamma activity; Cs^{137} levels in humans; environmental levels of radioactivity at AEC installations; and announced nuclear detonations. (M.C.G.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

Refer also to abstracts 16043, 16044, 16045, 16046, 16047, 16049, 16050, 16051, 16052, 16053, 16054, 16055, 16062, 16063, 16064, 16065, 16066, 16067, 16068, 16069, 16070, 16071, 16072, 16073, 16074, and 16075.

16620 MEASUREMENT OF THE HUMIDITY OF SOILS BY DIFFUSION OF A BEAM OF THERMAL NEUTRONS. Bernard Wack (Laboratoires de Mecanique des Fluides, Grenoble, France). Compt. rend., 254: 1002-4(Feb. 5, 1962). (In French)

From earlier results on the measurement of soil humidity an apparatus was constructed and calibrated for the measurement of the humidity of soils by diffusion of a beam of thermal neutrons. The construction and calibration of this apparatus are described in detail. (J.S.R.)

16621 OBSERVATIONS ON PACKAGED Pm^{147}-ACTIVATED PHOSPHOR LIGHT SOURCES. A. Bradley (Associated Nucleonics, Inc., Garden City, N. Y.). Intern. J. Appl. Radiation and Isotopes, 13: 15-18(Jan. 1962). (In English)

Self-luminous phosphor sources activated with Pm^{147} have given brightness levels superior to those attained with any other radioisotope. Unfortunately, the brightness decreased faster than the natural decay rate of the isotope due to radiation damage to the phosphor or container materials. Details of the construction and methods of testing of these sources are presented, and the decay problem is illustrated with experimental data. (auth)

16622 A RADIOACTIVE TECHNIQUE FOR THE CONTINUOUS MEASUREMENT OF FILM THICKNESS IN VACUUM DEPOSITED GOLD FILMS. T. P. Flanagan and J. A. Bennett (British Scientific Instrument Research Assn., Chislehurst, Kent, Eng.). Intern. J. Appl. Radiation and Isotopes, 13: 19-26(Jan. 1962). (In English)

In thin-film research a recurring problem is the measurement of film thickness during deposition of the layer. A satisfactory solution to this problem, in the case of gold films, is described. Radioactive gold is employed and the activity of the film is measured during the deposition process, enabling the mass per unit area at any instant to be determined. (auth)

16623 RADIATION STERILIZATION OF FOODS. COMPARISON OF THE RADIOSENSITIVITIES OF THE FAT-SOLUBLE VITAMINS BY GAMMA IRRADIATION. F. W. Knapp and A. L. Tappel (Univ. of California, Davis). J. Agr. Food Chem., 9: 430-3(Nov.-Dec. 1961).

In order to compare the radiosensitivities of fat-soluble vitamins under controlled conditions, they were each irradiated in pure solution, aerobically and anaerobically. Vitamin E was by far the most sensitive, followed in order by carotene and vitamins A, D, and K. Only vitamin E was affected adversely by the presence of oxygen during irradiation. Vitamins D and K were considerably stabilized. (auth)

16624 THE HOMOGENEOUS DOSE DISTRIBUTION OF SOME RADIATION-SOURCES. Th. Gruenewald (Bundesforschungsanstalt für Lebensmittelfrischhaltung, Karlsruhe, Ger.). Kerntechnik, 4: 104-9(Mar. 1962). (In German)

The geometry of the flux of artificial radiation sources is shown. The sources described are: a 60 kv-20 ma-x-ray generator with soft-radiation, a 120 kv-0.5 amp-high efficiency x-ray generator, and a 1 Mev-250 w electron generator. These research facilities are applied to the irradiation of foods with a large surface. The efficiency of the facilities for a given dose is investigated. The calculation of the dose for the different points within the irradiated samples is the same for radioisotopes as for the described electron generator and x-ray sources. (auth)

16625 RADIOAKTIVE STRAHLENQUELLEN IN DER TECHNIK. (Radioactive Radiation Sources in Engineering). Siegfried Koch. Leipzig, VEB Deutscher Verlag für Grundstoffindustrie, 1960. 120p. DM 7.80.

The applications and utilization of nuclear energy in industry are discussed. In particular radiation absorption and its application, radiation scattering and its uses, the efficiency of the ionization of gases by radiation, and the physical and technological characteristics of solid bodies by radiation are considered. A bibliography with 116 references is included. (M.C.G.)

ISOTOPE SEPARATION

Refer also to abstracts 16083, 16084, and 16085.

16626 (CEA-2010) ETUDE SUR SIMULATEUR DES REGIMES TRANSITOIRES DES CONCENTRATIONS DANS UNE INSTALLATION DE DIFFUSION GAZEUSE. (Simulator Study of Control of Concentration Transients in a Gaseous Diffusion Plant). P. Delarousse, C. Trouve, and R. Jacques (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 45p.

A finite difference system is used to describe concentration transients in a gaseous diffusion plant for uranium isotope separation. The equipment used in this study is described and examples are given to illustrate the problems which have been solved with it. (auth)

16627 (NUCLEAR-52) SEPARATION OF ISOTOPES GAS CENTRIFUGE PROCESS: SURVEY OF PUBLICATIONS. (Roe (A. V.) Canada Ltd. Orenda Engines Div., Malton, Ont.). Jan. 1, 1962. 65p.

A chronological listing of 125 unclassified references on gas centrifuge technology as applied to the separation of isotopes is presented. The survey covers the period from 1919 to 1962. An abstract of the original publication is given in most cases. Separate tabulations are included for cross referring between authors, report numbers, NSA reference numbers, and patent numbers. A summary of pertinent news released since 1959 is also given. (auth)

16628 THE SEPARATION OF HEAVY WATER. A. V. Brancker. Ind. Chemist, 38: 14-22(Jan. 1962).

Discussion is given on a detailed analysis of the physical and thermodynamic aspects of the separation process for the HDO/H_2O system. A practical interpretation of a complex problem based particularly on graphical methods, and a basis for the application of solar separation processes is given. It is concluded that the main difficulty in the separation process is graphical representation to the degree of accuracy required and also the fact that in practice it may not be easy to operate at the control precision indicated. (P.C.H.)

16629 ISOTOPE SEPARATION BY ELECTRODIFFUSION. M. M. Breuer (Gillette Industries, Ltd., Research Labs., Reading, Berks, Eng.). Nature, 194: 281-2(Apr. 21, 1962).

The possibility of using electrodiffusion to separate isotopes by means of the kinetic isotope effect is discussed. Electrodiffusion can be carried out in an ion exchange column, one half of which is saturated initially with a mixture of two isotopic ions which react with the resin to form immobile complexes. Calculations show that separation under these conditions is enhanced by the use of a-c at high applied voltages and frequencies higher than the reciprocals of the relaxation times of the reactions. (D.L.C.)

16630 IMPROVEMENTS IN OR RELATING TO CENTRIFUGES FOR THE SEPARATION OF ISOTOPES. Konrad Beyerle and Karl Heinz Welge. British Patent 893,647. Apr. 11, 1962.

A gas centrifuge for isotope separation is designed in which the problems of gas removal and mixing of separated gas fractions are solved. The centrifuge comprises a casing, a rotatable drum with a clearance space between itself and the casing, an aperture in the drum for gas supply thereto, and outlet ports in the drum for passage of separated gas fractions into the clearance. Subsequent mixing of separated gas fractions in the clearance space is minimized by gaps of high flow resistance disposed between the parts of the space into which the fractions pass. A plurality of such drum units may be constructed within a casing for efficient isotope separation. (D.L.C.)

MATHEMATICS AND COMPUTERS

Refer also to abstracts 16153 and 16154.

16631 (AERE-R-3980) FORTRAN FOR AUTOCODE PROGRAMMERS–AUTOTRAN. A. R. Curtis (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Feb. 1962. 25p.

A system is described for translating from AUTOCODE to FORTRAN. (J.R.D.)

16632 (ANL-6511) MULTIGROUP CALCULATIONS OF EFFECTIVE DELAYED-NEUTRON FRACTIONS, PROMPT-NEUTRON LIFETIME, AND RELATED KINETICS PARAMETERS. IBM-704 PROGRAM 1188/RE. L. C. Kvitek (Argonne National Lab., Ill.). Mar. 1962. Contract W-31-109-Eng-38. 57p.

In the course of a recent study of kinetics parameters, it was found that RE-185, because of its limitations, was inadequate to handle the problems involved with the reactors considered. Program 1188/RE was written entirely independent of and is intended to make RE-185 obsolete. The multigroup calculations of primary interest performed by the code are as follows: the total effective delayed-neutron fraction and its distribution into six "families" which are characterized by their periods; the prompt-neutron lifetime; and the worth of delayed and prompt neutrons in the core and blanket regions for all fissionable materials. Fluxes used in these calculations are taken directly from the real and adjoint solutions as obtained by RE-122. (auth)

16633 (DC-59-12-83) MONTE CARLO RESEARCH SERIES: FORTRAN MONTE CARLO PROGRAMS: PART I. J. R. Beeler (General Electric Co. Aircraft Nuclear Propulsion Dept., Evendale, Ohio). Oct. 1959. Contract AT(11-1)-171. 31p.

The FORTRAN II coding system allows use of previously coded and checked out CAGE subroutines and programs as components in a FORTRAN program. This capability makes FORTRAN a useful tool for constructing a special purpose Monte Carlo experiment quickly. The values of vital parameters for either a numerical calculation or a laboratory experiment can be obtained from such special purpose Monte Carlo codes. The computational devices needed to construct an analog Monte Carlo experiment are described. A flow chart is given which illustrates how to interconnect these computational units in order to solve neutron and photon transport problems. (auth)

16634 (JINR-D-810) DETERMINATION OF THE COORDINATES OF THE MINIMA OF FUNCTIONALS BY THE LINEARIZATION METHOD. S. N. Sokolov and I. N. Silin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 19p.

A method of minimization is suggested which is applicable to the functionals dependent on the parameters sought for exclusively through the functional argument, and having convergence significantly better than that of the general methods in common use. The method is highly efficient in solving a number of concrete problems. (auth)

16635 A PARTICLE IDENTIFICATION SYSTEM. L. Wåhlin (National Physical Research Lab., C.S.I.R., Pretoria). Nuclear Instr. & Methods, 14: 281-7(Jan. 1962). (In English)

A simple low cost computer which can be used to discriminate between particles with different mass is described. A feature of this computer is a log and antilog device consisting of biased diodes and summing networks. (auth)

16636 SYSTEM FOR AUTOMATIC RECORDING OF NUCLEAR DATA. Peter Alexander (Purdue Univ., Lafayette, Ind.). Nuclear Instr. & Methods, 14: 288-96(Jan. 1962). (In English)

Described is a system which permits data to be recorded simultaneously on nine scaler units each composed of from four to seven decade scaling strips. Data from the last four scaling strips in each of the scaler units are periodically punched (and printed) on I.B.M. cards for direct presentation to an electronic digital computer. The scaler units with seven scaling strips are capable of recording data at the rate of 10^6 events per second while the scaler units with four scaling strips may record data at 10^5 events per second. Data "punch-out" time for the nine scaler units may be made as small as 10 sec. Also described is a method whereby the system may be expanded to punch-out readings from 1 up to 25 scaler units. Each scaler unit may comprise any desired number of scaling strips from which the readings on up to the last ten scaling strips may be recorded. (auth)

16637 EQUIVALENCE BETWEEN THE TWO GENERALIZED MASTER EQUATIONS. S. Fujita (Université Libre, Brussels). Physica, 28: 281-97(Mar. 1962). (In English)

Forms of the generalized master equation derived by L. Van Hove (Physica, 23: 441(1957)) and by I. Prigogine and P. Résibois (Physica, 27: 629(1961)) are examined using diagrams. Given the random phase initial condition, they equivalently describe the exact asymptotic behavior of a diagonal element of density matrix. Their interrelation is clarified. Both of the equations exhibit non-Markoffian evolution. The way in which they are derived suggests which conditions and in what manner such non-Markoffian equations are reduced to the usual Markoffian master equations. (auth)

16638 PRESSURE COMPENSATED FIELDS. R. Pratap. Z. Astrophys., 52: 272-8(1961). (In English)

The differential equation for vector fields satisfying the relation that the vector product of the vector with its curl gives the gradient of a scalar function of position is solved in spherical coordinates. The results are applied to problems in hydrodynamics and hydromagnetics. (auth)

16639 GROUP THEORY AND ITS APPLICATION TO PHYSICAL PROBLEMS. Morton Hamermesh. Addison-Wesley Series in Physics. Reading, Massachusetts, Addison-Wesley Publishing Company, Inc., 1962. 520p. $15.00.

The uses of group theory in the treatment of physical problems are expounded, with particular attention to the concepts of symmetry and invariance. The subjects elucidated include symmetry groups, group representations, irreducible representations of the point symmetry groups, the symmetric group, continuous groups, axial and spherical symmetry, linear groups in n-dimensional space, irreducible tensors, ray representations, little groups, and applications to atomic, nuclear, and other physical problems. (T.F.H.)

16640 METHODS OF MATHEMATICAL PHYSICS. R. Courant and D. Hilbert. Volume II. Partial Differential

Equations. R. Courant. New York, Interscience Publishers, 1962. 847p. $17.50.

The application of partial differential equations to physical problems is studied from the viewpoint of mathematical physics. Attention is given to partial differential equations of first and higher order, hyperbolic partial differential equations in two or more independent variables, elliptic partial differential equations, and potential theory. (T.F.H.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

Refer also to abstracts 16052, 16066, and 16067.

16641 (ARL-59) STUDIES OF THE PARTICLE-IMPACT PROCESS FOR APPLYING CERAMIC AND CERMET COATINGS. Final Summary Report. D. G. Moore, A. G. Eubanks, H. R. Thornton, W. D. Hayes, Jr., and A. W. Crigler (National Bureau of Standards, Washington, D. C.). Apr. 1961. Contract AF33(616)-58-19. 52p. (AD-266381)

A basic study was made of the particle-impact process for applying coatings of aluminum oxide. One rod-type and two powder-type flame-spraying guns were used in the work. The coatings were found to consist primarily of the softer eta phase rather than the harder and more stable alpha form of alumina. It was established that the eta phase forms because of the high quenching rates. Calculated quenching rates were of the order of 800,000°C/sec on a stainless steel substrate and 34,000°C/sec on glass. Size and velocity measurements were made for particles from both gun types. High-speed motion pictures showed that the powder guns sprayed particles continuously; the rod gun in bursts. Most of the particles from both gun types were found to be molten at normal spraying distances. Severe deformation and radial flow occurred when they struck a smooth surface. For the relatively low velocity powder-gun particles, the flow on a glass substrate sometimes resembled that of a water drop striking a smooth plate. At high velocities (rod gun spraying) the molten particles appeared to be atomized into very small droplets when they struck a polished metal. On a roughened surface, however, there was little of this effect. The coating layer on an iron substrate was shown to be under compression at room temperature. This compression attenuated on heating and changed to tension at higher temperature. A residual stress gradient was found to be present in the coating layer after it was removed from the iron. A chemical bond sufficient to withstand interfacial stresses without spontaneous failure was developed between the coating and smooth glass substrates, but never between the coating and smooth metal. It was shown that the apparent bond strength between the coating and iron increased exponentially with increasing roughness of an iron surface, rather than linearly, which would be expected if the bond was chemical. Strong bonds were obtained on smooth iron specimens that had been oxidized in steam. However, the outer surface of oxide was found to be rough. When this outer surface was polished prior to flame spraying the alumina layer no longer adhered. (auth)

16642 (EURAEC-3) SINTERED URANIUM OXIDE: SINTERING TECHNIQUE AND BEHAVIOR UNDER IRRADIATION. Quarterly Report No. 1, Fourth Quarter 1960. (France. Commissariat à l'Énergie Atomique, Paris). Work performed under United States-Euratom Joint Research and Development Program. Contract 031-60-10RDF. 56p.

Uranium oxide powders prepared in a continuous rotating furnace can be sintered, at laboratory level and at semi-industrial level, at high density. At 1650°C in a cracked ammonia atmosphere this gives stoichiometric products, the average density of which is 95% of the theoretical density. At semi-industrial level, however, the dispersion is greater still; this seems to be due both to insufficient reproducibility of the sintering conditions and to an evolution of the properties of the powders when stockpiled. (auth)

16643 (EURAEC-194) SINTERED URANIUM OXIDE: SINTERING METHODS [AND] BEHAVIOUR UNDER IRRADIATION. Quarterly Report No. 4, 3rd Quarter, July 1 to September 30, 1961. (France. Commissariat à l'Énergie Atomique, Paris). Oct. 13, 1961. Work performed under United States-Euratom Joint Research and Development Program. Contract 031-60-10RDF. 48p.

Progress on uranium oxide sintering methods and behavior under irradiation is reported. Separate abstracts were prepared for each of the seven sections. (M.C.G.)

16644 (EURAEC-194(App.1)) USE OF A ROTARY LABORATORY FURNACE FOR PREPARING HIGHLY REACTIVE POWDERS OF URANIUM DIOXIDE. G. Allard and P. Chenebault. (Compagnie Générale de Télégraphie sans Fil, Paris). Appendix 1 of SINTERED URANIUM OXIDE SINTERING METHODS BEHAVIOUR UNDER IRRADIATION. Quarterly Report No. 4, 3rd Quarter, July 1 to September 30, 1961. p.5-9.

The preparation of highly reactive powders of UO_2 is being continued. Experimental conditions and results of parameter variations are given in tabular form. (M.C.G.)

16645 (EURAEC-194(App.2)) MOLDING OF URANIUM DIOXIDE. (Compagnie Industrielle des Combustibles Atomiques Frittés, Corbeville, par Orsay (Seine-et-Oise), France). Oct. 1961. Appendix 2 of SINTERED URANIUM OXIDE SINTERING METHODS BEHAVIOUR UNDER IRRADIATION. Quarterly Report No. 4, 3rd Quarter, July 1 to September 30, 1961. p.10-30.

Dry-molding of UO_2, without binder, was further investigated. Molding tests on a semi-industrial scale by double compression cycle of UO_2 performed in a running furnace proved to be satisfactory. The first molding tests by a single compression cycle revealed that this simplified process cannot be applied indiscriminately to all powders. Sintering tests in atmospheres of cracked ammonia and hydrogen showed little difference between them. (M.C.G.)

16646 (EURAEC-194(App.3)) RESISTANCE TO THERMAL SHOCK. M. Brandela (Compagnie Générale de Télégraphie sans Fil, Paris). Oct. 1961. Appendix 3 of SINTERED URANIUM OXIDE SINTERING METHODS BEHAVIOUR UNDER IRRADIATION. Quarterly Report No. 4, 3rd Quarter, July 1 to September 30, 1961. p.31-33.

An investigation was made of the bearing of diameter on the resistance to thermal shock of pellets with a density of 10.3. The diameters under investigation were 14, 10.8, and 4 mm. The resistance to thermal shock of a cylindrical sample of sintered UO_2 was inversely proportional to its diameter. (M.C.G.)

16647 (EURAEC-194(App.4)) LABORATORY STUDY OF THE USE OF MOIST HYDROGEN AS SINTERING ATMOSPHERE. Preliminary Tests. B. Francois (Compagnie Générale de Télégraphie sans Fil, Paris). Appendix 4 of SINTERED URANIUM OXIDE SINTERING METHODS BEHAVIOUR UNDER IRRADIATION. Quarterly Report No. 4, 3rd Quarter, July 1 to September 30, 1961. p.34-5.

Sintering of UO_2 was performed at 1450 and 1600°C in dry hydrogen and in hydrogen which was moistened to 150 mg per liter in the saturation column at 60°C. Densities of 9.82, 10.15, 10.35, and 10.53 were obtained in dry hydrogen while 9.96, 10.25, 10.33, and 10.48 were obtained under the same conditions in moist hydrogen. (M.C.G.)

16648 (EURAEC-194(App.5)) UO$_2$ SINTERINGS PRELIMINARY TO IRRADIATION IN EL$_3$. G. DeTiffe (Compagnie Générale de Télégraphie sans Fil, Paris). Appendix 5 of SINTERED URANIUM OXIDE SINTERING METHODS BEHAVIOUR UNDER IRRADIATION. Quarterly Report No. 4, 3rd Quarter, July 1 to September 30, 1961. p.36-9.

Sintering tests on 1.6% enriched UO$_2$ powder molded at 0.750, 1.4, and 1.5 T/cm^2 gave curves of raw density versus sintered density that were almost horizontal at 10.2, 10.4, and 10.6 respectively. (M.C.G.)

16649 (EURAEC-194(App.6)) EXPERIMENTS ON HARD-SOLDERING OF STAINLESS STEEL THERMOCOUPLE LEAD-IN TUBES INTO ZIRCALLOY-2 CARTRIDGE PLUGS. B. Bernardi de Sigoyer (Compagnie Générale de Télégraphie sans Fil, Paris). Appendix 6 of SINTERED URANIUM OXIDE SINTERING METHODS BEHAVIOUR UNDER IRRADIATION. Quarterly Report No. 4, 3rd Quarter, July 1 to September 30, 1961. p.40-3.

Studies were made to obtain tight joints between the stainless steel lead-in tubes for thermocouples and the Zircaloy-2 plugs. The method of hard-soldering was used. An intermediate-size stainless steel tube was hard-soldered to the Zircaloy plug. The thermocouple was passed through this tube and its sheath was subsequently hard-soldered onto the free end of the gun. (M.C.G.)

16650 (EURAEC-194(App.7)) DIFFUSION OF FISSION GASES IN UO$_2$. A. Schuerenkaemper and A. M. Tachis (Compagnie Générale de Télégraphie sans Fil, Paris). Appendix 7 of SINTERED URANIUM OXIDE SINTERING METHODS BEHAVIOR UNDER IRRADIATION. Quarterly Report No. 4, 3rd Quarter, July 1 to September 30, 1961. p.44-7.

UO$_2$ samples were irradiated 5 days with a flux of 2×10^{12} n/cm^2/sec. Activated carbon was used to absorb the diffused gases in a trap small enough to introduce into the well of a hollow crystal. It appeared that for UO$_2$ with a density of 10.6, 1200°C constitutes the limit for following the activity with respect to time. After diffusion the samples were dissolved in melted potassium pyrosulfate in order to liberate all the activity of rare gases contained in the sample. The calibration needed for the quantitative measurement of liberated gas was performed. (M.C.G.)

16651 THE INDUCTION MELTING AND CASTING OF BERYLLIUM. R. Goosey, R. A. Knight, and A. J. Martin (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Less-Common Metals, 4: 199-212(Apr. 1962). (In English)

A study was made of the defects normally found in vacuum-cast, induction melted beryllium ingots. The defects were classified according to metal source, and the extent to which they may be eliminated is shown to be dependent upon conditions of casting, such as teeming temperature, rate of pour, and pre-treatment of the raw material. A center-line defect, present in certain grades of thermally-reduced metal may result from the segregation of titanium, and appears to be removed by alloying with aluminum. (auth)

16652 THE PREPARATION OF URANIUM OXIDE SINGLE CRYSTALS BY SUBLIMATION. W. Van Lierde, R. Strumane, E. Smets, and S. Amelinckx (Studiecentrum voor Kernenergie, Mol, Belg.). J. Nuclear Materials, 5: 250-3(Feb. 1962). (In English)

A new method for growing uranium dioxide single crystals from the vapor is described. Crystals from 4 to 12 mm in size, and up to 5 g in weight are easily obtained. Control by Laue diffraction patterns and chemical analysis showed these crystals to be of high perfection and purity. (auth)

16653 SURFACE COATINGS FOR BERYLLIUM PARTS. Dennis O'Boyle (General Motors Corp., Milwaukee). Machine Design, 33: 147-50(Dec. 21, 1961).

The coatings currently being used on beryllium, their relative merits, and how they are specified are discussed. Oxide coatings, electroless plating, electroplating, and flame spraying are described. (M.C.G.)

16654 NUCLEAR REACTOR FUEL ELEMENTS. METALLURGY AND FABRICATION. Albert R. Kaufmann, ed. New York, Interscience Publishers, 1962. 750p. $27.00.

A compendium is presented on the technology associated with reactor fuel element fabrication in the U. S. Included are 18 chapters, for each of which a separate abstract was prepared. (J.R.D.)

16655 ENERGY FROM NUCLEAR FISSION. Samuel Glasstone. p.1-12 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

The essential principles of reactor design and operation are discussed in sections on atomic structure and isotopes, radioactivity, neutron reactions, fission process, and nuclear reactors. (J.R.D.)

16656 FUEL-ELEMENT PROBLEMS. Albert R. Kaufmann. p.13-30 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

Problems associated with development and use of fuel elements are examined in sections on nuclear fuels, operating conditions, cost, design limitations, fuel-element life, reactor catastrophe, and fuel reprocessing. (J.R.D.)

16657 URANIUM AND ITS ALLOYS. J. L. Klein. p.31-91 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

The metallurgy and properties of metallic U and its alloys are examined in sections on U metal preparation, U alloys, corrosion, and thermal cycling. (J.R.D.)

16658 PLUTONIUM AND ITS ALLOYS. L. R. Aronin. p.92-145 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

The metallurgy of Pu and its alloys are examined in sections on handling, production, physical and chemical properties. Pu metal working, mechanical properties of Pu metal, Pu alloys, and radiation effects. (J.R.D.)

16659 THORIUM AND ITS ALLOYS. I. B. Roll. p.146-93 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

Aspects of preparation and properties of Th and its alloys are presented in sections on occurrence, extraction, reduction, casting, physical properties, radiation effects, mechanical properties, structure, fabrication, corrosion, and Th-base alloys. (J.R.D.)

16660 URANIUM DIOXIDE AND OTHER CERAMIC FUELS. N. R. Gardner. p.194-230 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

The properties, fabrication, and performance of carbides and other U compounds are compared with those of UO_2. Th and Pu oxides are also discussed. (J.R.D.)

16661 CLADDING MATERIALS. J. P. Pemsler. p.231-56 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

A discussion of cladding materials now in use is presented. The potential for development of new cladding materials is also discussed. (J.R.D.)

16662 INTERACTIONS BETWEEN CORE AND CLADDING. S. H. Gelles. p.257-91 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

Problems involving various core/cladding combinations are discussed. Included are sections containing important considerations related to these combinations, and examples. (J.R.D.)

16663 BEHAVIOR OF FISSIONABLE MATERIAL UNDER IRRADIATION. A. Boltax. p.292-361 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

A survey of fissionable material radiation effects is presented in which the detailed anatomy of a solid-fuel element is used as a model for examination of the major reactor-materials problems. It is noted that the largest single problem is swelling. (J.R.D.)

16664 ENGINEERING ASPECTS OF FUEL ELEMENTS. J. A. Ransohoff. p.362-82 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

Factors which affect the design of fuel elements for the more demanding situations are considered. Included are sections on considerations in physics, radiation damage, and corrosion, elementary heat transfer, elementary fluid mechanics, hot-channel effects, nonuniform flux distribution effects, reactor transients, and thermal stresses. (J.R.D.)

16665 FABRICATION OF CORE MATERIALS. P. Loewenstein, P. D. Corzine, and J. Wong. p.383-426 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

The fabrication of core materials is discussed. Included are sections on melting and casting, powder-metallurgy fabrication, plastic working, fusion welding, and machining. (J.R.D.)

16666 CLADDING AND BONDING TECHNIQUES. F. M. Yans, P. Loewenstein, and J. Greenspan. p.427-503 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

The information is mainly concerned with the various techniques developed for canning U and Th fuel elements with Al, Mg, Zr, or stainless steel. Some alloys of these core and cladding materials are also discussed. Procedures used to apply diffusion barriers for prevention of core-cladding interaction and methods used to achieve heat-transfer promoting bonding are included. (J.R.D.)

16667 FUEL SUBASSEMBLY CONCEPTS. J. H. Johnston. p.504-19 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

A discussion is presented concerning the arrangement and fabrication of fuel subassemblies from an over-all point of view. Examples were selected to help in the description of possible configurations and the methods of building these along with the relations of the subassemblies to the reactor. (J.R.D.)

16668 INSPECTION AND TESTING. Welville B. Nowak. p.520-55 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

Included is information on necessity for inspection and testing of fuel elements, characteristics which require inspection and testing, fabrication schedule inspection and testing stations, and methods of inspection and testing. (J.R.D.)

16669 DESCRIPTION AND PERFORMANCE OF OPERATIONAL FUEL ELEMENTS. L. R. Aronin and B. W. Rothleder. p.556-621 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

Included are discussions on the ORNL Graphite Reactor, the NRX Reactor, the Brookhaven Reactor, the MTR, the Argonne Cp-5, the EBWR, the Borax-4, the Army SM-1, the SRE, the OMRE, the PWR, the French EL-2, and the Calder Hall Reactors. (J.R.D.)

16670 PROCESSING IRRADIATED FUEL ELEMENTS. Saul Isserow. p.622-37 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

Aspects of processing most closely related to fuel design are summarized. General considerations are discussed and information on aqueous processes, nonaqueous methods, effects of fuel-element composition on processing, and cost of reprocessing is presented. (J.R.D.)

16671 FLUID-FUEL SYSTEMS. Saul Isserow. p.638-43 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

The inherent advantages introduced by fluid fuels are pointed out along with the disadvantages of solid fuels. The various shortcomings of fluid fuels are also discussed. Other information is included on aqueous homogeneous fuels, liquid metal fuels, and fused inorganic fuels. (J.R.D.)

16672 FUEL-ELEMENT ECONOMICS. Bruce S. Old (Arthur D. Little, Inc., Cambridge, Mass.) and David P. Herron. p.644-55 of "Nuclear Reactor Fuel Elements. Metallurgy and Fabrication." New York, Interscience Publishers, 1962.

Fuel-element economics are considered for power reactors alone. Included are sections on capital plant costs, fuel-cycle economics, and outlook for the future. (J.R.D.)

16673 WATER COOLED RETORT COVER. W. J. Ash and J. F. Pozzi (to U. S. Atomic Energy Commission). U. S. Patent 3,033,549. May 8, 1962.

A retort cover is designed for use in the production of magnesium metal by the condensation of vaporized metal on a collecting surface. The cover includes a condensing surface, insulating means adjacent to the condensing surface, and a water-cooled means for the insulating means. The arrangement of insulation and the cooling means permits the magnesium to be condensed at a high temperature and in massive nonpyrophoric form. (AEC)

Corrosion

16674 (ARF-2198-24) IMPROVED ZIRCONIUM ALLOYS. Quarterly Report, October 1, 1961 to December 31, 1961. D. Weinstein and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 12, 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-578. 12p. (EURAEC-262)

The corrosion properties of ternary zirconium alloys in 680°F water for a duration of 2040 hr were determined. A trend evident in the results was that the addition of chromium and tellurium was beneficial to corrosion resistance. All the ternary compositions tested exhibited better corrosion resistance than the binary Zr–0.5 Nb alloy. Attempts to produce electron-beam refined materials with a precipitate-free microstructure were unsuccessful. This electron-beam melted material had slightly less corrosion resistance than sponge or iodide zirconium in 680°F water for 336 hr. (M.C.G.)

16675 (ORNL-2834) AN INVESTIGATION OF THE CORROSION RESISTANCE OF BRAZING ALLOYS FOR AUSTENITIC STAINLESS STEEL FUEL ELEMENTS FOR SERVICE IN 565°F PRESSURIZED WATER. R. J. Beaver, C. F. Leitten, Jr., and J. L. English (Oak Ridge National Lab., Tenn.). Apr. 12, 1962. Contract W-7405-Eng-26. 38p.

Since brazing was the method selected for joining the stainless steel SM-1 reactor fuel element, corrosion studies were conducted on various potential brazing alloys to evaluate their resistance under the approximate pressurized-water conditions of the SM-1. The program consisted mainly of testing type 304L stainless steel "T" joints brazed with selected alloys in quiescent, degassed, and deionized autoclaved water at 565°F under 1200-psi pressure. In the initial phase of the investigation, tests were limited in duration to 1000 hr in order to quickly screen some 18 potential alloys for longer time testing. Based on weight-change data and the metallographic examinations, five of the 18 alloys exhibited sufficient corrosion resistance to warrant further investigation. These alloys were subjected to autoclave tests of 12 and 16 months. In these extended tests, 1 cc O_2/liter and a mixture of 1 cc O_2/liter plus 50 cc H_2/liter, respectively, were added to the water to more closely simulate SM-1 reactor water conditions and to evaluate the effect of different gaseous additions on the corrosion behavior of the alloys. On the basis of weight-change data and metallographic examination after long-term exposure of the tested stainless steel-base joints these alloys were considered to have acceptable corrosion resistance. No significant differepces in the corrosion behavior of these alloys were noted between testing in oxygenated water and water containing the oxygen-hydrogen mixture. (auth)

16676 (TID-7626(Pt.I)) NASA–AEC LIQUID METALS CORROSION MEETING [HELD] DECEMBER 14-15, 1961, BROOKHAVEN NATIONAL LABORATORY, UPTON, LONG ISLAND, NEW YORK. (National Aeronautics and Space Administration, Washington, D. C. and Atomic Energy Commission, Washington, D. C.). 193p.

Twenty-two papers are included. Separate abstracts were prepared for fifteen of these. The presentations not abstracted concern liquid metal research, evaluation of materials in gaseous and liquid Hg, liquid metal corrosion, of loop materials, effects of K vapor on refractory alloys, research program on Na components, Na loop studies, and determination of O in Na. (J.R.D.)

16677 (TID-7626(Pt.I)(p.23-34)) VAPOR-LIQUID CORROSION STUDIES IN MERCURY AND SODIUM SYSTEMS. A Fleitman, A. Romano, and C. Klamut (Brookhaven National Lab., Upton, N. Y.).

The corrosive behavior of Hg vapor and liquid at 600 to 1400°F is being investigated. The study is primarily concerned with the long-term corrosion of carbon steel and the effects of Ti or Zr additions to the Hg. The corrosion of refractory metals by Hg is also being studied. In other work, corrosion of refractory metals, especially Nb–Zr alloys, by Na vapor and liquid at 1500 to 2400°F is being investigated. Experimental apparatus and results are discussed. (J.R.D.)

16678 (TID-7626(Pt.I)(p.42-62)) ALKALI-METAL CORROSION STUDIES AT ROCKETDYNE. W. T. Chandler (Rocketdyne. Div. of North American Aviation, Inc., Canoga Park, Calif.).

A summary is presented of activities in studies concerning elevated temperature corrosive properties of Na, K, Cs, and Ru. Information is included on design of boiling K and Na loops and results of corrosion tests on various refractory metals. In other work, capsules of Hastelloy-X and Nb–Zr alloys containing tabs of Nb, Nb–Zr alloys, or other refractory materials were exposed to K at 1450 to 2000°F. Design and construction of high-temperature Nb–Zr alloy loops for containment of boiling K are also discussed. A brief review of Cs corrosion work is included along with a reference to a research program on bearings lubricated by liquid K and Cs. (J.R.D.)

16679 (TID-7626(Pt.I)(p.63-8)) POTASSIUM CORROSION STUDIES. E. A. Kovacevich (AiResearch Mfg. Co. [Div. of Garrett Corp.], Phoenix, Ariz.).

Results of tests conducted in the SPUR program are reviewed. The static experiments in this program were conducted with K and included refluxing and standard capsule tests, while the dynamic experiments were evaluated in forced circulation loops. The static tests involved exposure of Hastelloy-X, Mo–Zr alloys, W, Mo–Ti alloys, and Co–W alloys at 1000 to 1800°F. The dynamic tests involved loops constructed of Hastelloy-X and Nb–Zr alloy. These loops were operated at high-temperature until failure. (J.R.D.)

16680 (TID-7626(Pt.I)(p.69-86)) LIQUID METAL INVESTIGATIONS. J. W. Semmel, Jr. (General Electric Co. Flight Propulsion Lab. Dept., [Cincinnati]).

The technology underlying the development of nuclear turboelectric space power-generating systems is briefly discussed in the areas of liquid metal heat transfer, turbine operation in K vapor, and materials development for alkali metal containment. Work on corrosion of Haynes alloy 25 in K is reported in more detail. Most data were gathered at 1850°F in 1000-hour tests. Corrosion data are also included which were obtained in convection loops constructed of Haynes 25 containing samples of Zr, Nb–Zr alloys, and Mo–Ti alloys in liquid K. (J.R.D.)

16681 (TID-7626(Pt.I)(p.87-91)) LIQUID METAL CORROSION RESEARCH IN THE SNAP DEVELOPMENTAL PROGRAM. M. A. Perlow and J. P. Page (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.).

A discussion of the SNAP 2, 8, and 10A cooling systems is presented. Materials for use in these systems include Hastelloy C and N, Stainless 316, and Haynes alloy 25. These materials were tested in NaK at 1200 to 1500°F. Results are also discussed. (J.R.D.)

16682 (TID-7626(Pt.I)(p.92-100)) CARBON TRANSFER IN LIQUID SODIUM SYSTEMS. W. J. Anderson (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.).

Results of carburization experiments on 304 stainless steel in Na at 1000 to 1600°F are presented. (J.R.D.)

16683 (TID-7626(Pt.I)(p.107-8)) MERCURY CORROSION OF TITANIUM AND TITANIUM ALLOYS AT ELEVATED TEMPERATURES. James Y. N. Wang (Argonne National Lab., Ill.).

Corrosion of Ti and Ti alloys by Hg at 700°F is being investigated. Corrosion data are included for Ti–7Al–12Zr, Ti–2.5Al–16V, Ti–5Al–5Sn–5Zr, and Ti–8Al–1Mo–1V during exposure for 30 days. (J.R.D.)

16684 (TID-7626(Pt.I)(p.109-10)) COMPATIBILITY OF CONTAINMENT METALS WITH CESIUM. J. J. Crosby (Aeronautical Systems Div., Wright-Patterson AFB, Ohio).

An investigation in progress on the compatibility of stainless steel, Inconel X, Zr, Hf, Ta, Nb, Mo, W, and Nb–Zr alloys with Cs at 1600 to 2500°F is reported. (J.R.D.)

16685 (TID-7626(Pt.I)(p.111-14)) WORKING FLUIDS PROGRAM. David A. Kirk and John A. Roth (Aeronautical Systems Div. Materials Central, Wright-Patterson AFB, Ohio).

Discussions pertaining to the thermophysical properties of Ru at 2000°F and below, and pertaining to determination of impurities in this metal are presented. Research on high-temperature liquid metal condensation is also reported. (J.R.D.)

16686 (TID-7626(Pt.I)(p.128-9)) ALKALI METAL ANALYTICAL PROGRAM AT OAK RIDGE NATIONAL LABORATORY; DETERMINATION OF OXYGEN IN POTASSIUM J. C. White (Oak Ridge National Lab., Tenn.).

A review of ORNL developments on analysis methods for determining O in K is presented. These include chemical and radiometric analyses. (J.R.D.)

16687 (TID-7626(Pt.I)(p.130-40)) DEVELOPMENTS IN THE ANALYSIS OF OXYGEN IN ALKALI METAL. H. Kirtchik and G. Riechmann (General Electric Co. [Aircraft Nuclear Propulsion Dept.], Cincinnati).

Activities are described in a program to develop a single procedure for O in alkali metals. Included are descriptions of a sampling device, and developmental information on an alkyl halide method for O, and a fluoride method for O. (J.R.D.)

16688 (TID-7626(Pt.I)(p.141-2)) EVALUATION OF EXISTING METHODS AND NEW PROPOSALS FOR THE DETERMINATION OF OXYGEN IN SODIUM. Leonard Newman (Brookhaven National Lab., Upton, N. Y.).

Methods for determining O in Na are described. One method is based on conversion of Na to NaBr with subsequent conversion to Na_2O and titration with HCl. Another approach involves an amalgamation technique which relies on dissolving the Na in Hg and allowing the oxide to float on top. A third approach is that of vacuum distilling the Na away from the oxide and a fourth approach is H reduction of the oxide with subsequent Karl Fischer water titration. (J.R.D.)

16689 (TID-7626(Pt.I)(p.143-5)) SUMMARY OF LIQUID METAL ACTIVITIES AT UNITED NUCLEAR. J. M. McKee and H. Steinmetz (United Nuclear Corp. Development Div., White Plains, N. Y.).

Activities in liquid metal research are reported. Included are descriptions and data on determining O and C in Na, measurements of the solution rate and solubility of Ni and Fe in Li, and boiling sodium heat transfer. (J.R.D.)

16690 (TID-7626(Pt.I)(p.146-9)) DETERMINATION OF CARBON IN SODIUM DEPOSITION OF REFRACTORY COATINGS FROM LIQUID METAL MEDIA; PROPERTIES OF MATERIALS EXPOSED TO 1200°F SODIUM. J. W. Mausteller and F. Tepper (MSA Research Corp., Callery, Penna).

Development of a method for determining C in Na is reported. Experiments are described concerning deposition of TiB_2 from molten Na–B systems in which Ti rods were suspended. Coatings deposited on various refractory samples provided limited protection. (J.R.D.)

16691 (TIM-435) HASTELLOY X FORCED CONVECTION NaK CORROSION LOOP TESTS, HXLM-1 AND 2. R. C. Shaw (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Sept. 19, 1958. Contract [AT(11-1)-229]. 13p. (TID-12232)

To obtain information on the corrosion resistance of Hastelloy X to NaK, two type 316 stainless steel test loops with Inconel pump cells were modified to incorporate Hastelloy X heater legs. Each loop contained a heater and cooler section so that temperature gradients could be established in the NaK in the direction of flow. By-pass type cold traps were installed in the minimum temperature zones of the loops and were maintained at 700 to 750°F to remove oxide contamination. HXLM-1 and HXLM-2 were operated for 500 and 576 hr respectively while maintaining maximum temperatures of 1510 and 1500°F. Minimum temperatures were 1100°F. Post-test analysis revealed 1.7 and 1.5 mils surface and subsurface void attack in the Hastelloy X heater legs while the stainless steel coolers showed a depleted layer of 1 mil. The loops contained 4.5 and 5.0 mils of mass transfer deposit. (auth)

16692 (TIM-490) TYPE 316 STAINLESS STEEL FORCED CONVECTION SODIUM CORROSION LOOP TESTS SSSA-1A1, SSSA-2C2, SSSA-3C3 AND SSSA-5F1. R. C. Shaw (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). July 2, 1958. Contract [AT(11-1)-229]. 20p. (TID-12224)

Na was pumped through 4 test loops constructed of 316 stainless steel to determine the resistance of this material to corrosion and mass transfer. Results are tabulated for operating temperatures of 1050 and 1600°F. It was tentatively concluded that stainless steel has moderately good mass transfer and corrosion resistance; however, since the tests were of a preliminary nature, confirmation tests are recommended. (J.R.D.)

16693 ATTACK OF MOLYBDENUM BY LIQUID CERIUM. Françoise Gaume-Mahn and Monique Blanchard. Compt. rend., 254: 1082-3(Feb. 5, 1962). (In French)

The behavior of Mo in the presence of liquid Ce at temperatures between 800 and 1200°C was studied by fusion in pure argon atmosphere of cerium samples at 800, 900, 1000, 1100, and 1200°C for an hour in Mo crucibles. After cooling the Ce is isolated, and the Mo is determined by spectrophotometry. The results show that the Mo concentration in the Ce increases rapidly when the temperature increases. This indicates that Mo can be used as a crucible at 800°C for the purification of cerium by the zone-melting technique. (J.S.R.)

16694 FORMATION OF EMBRYOS BY CATHODIC OXIDATION OF URANIUM. RELATIONSHIP TO THE STRUCTURE. H. Aubert (Centre d'Études Nucléaires, Saclay, France). J. Nuclear Materials, 5: 173-7(Feb. 1962). (In French)

The cathodic oxidation of depassivated uranium after polishing in a perchloric acid bath leads to the formation of oxide embryos which, under certain conditions of oxidation are joined to the underlying metal. With an oxygen pressure in the range $10^{-2}-10^{-3}$ mm of Hg, and an oxidation period reduced to 20 sec, good reproducibility is obtained. However, there is no one-to-one relationship between the oxide embryos and dislocations. (auth)

16695 CORROSION BY URANIUM HEXAFLUORIDE. PART 2. J. Dixmier, R. Hasson, S. Maraval, and L. M. Vincent (Centre d'Etudes Nucléaires, Saclay, France). J. Nuclear Materials, 5: 200-7(Feb. 1962). (In French)

A method, which permits measurements of high sensitivity (some millimicrons of penetration) of attack by UF_6 or other corrosive agents, under tried conditions of an industrial laboratory, is described. The sources of scatter in discontinuous measurements dictated by the nature of the objectives in view were analyzed. The principal sources are: machining of samples, weighing errors, and temperature variations. Scatter due to each of the factors was compared with the total scatter of the results. Comparison shows that the results are reproducible and that the accuracy remains good over a wide range of values. (P.C.H.)

16696 THE SQUEEZE ENERGY PRINCIPLE AND THE OXIDATION OF MAGNESIUM AND OF MAGNOX A 12. J. E. Castle (Univ. of Exeter, Eng.), S. J. Gregg, J. E. Antill, and W. B. Jepson. J. Nuclear Materials, 5: 254-6 (Feb. 1962). (In English)

A true comparison of the oxidation kinetics of magnesium and of Magnox A 12 and a test of the squeeze energy principle was made from oxidation measurements in oxygen from which the deleterious impurity was removed. Experiments were made in gettered and ungettered oxygen at 525°C. The reduction in weight gain produced by gettering was striking. It is concluded that in gettered oxygen, at 525°C, magnesium and Magnox A 12 are virtually equally resistant to oxidation, although the possibility of ultimate film breakdown in the case of magnesium was not excluded. It therefore seems that the superior oxidation resistance of Magnox A 12 over that of magnesium is not to be interpreted in terms of the squeeze energy principle, but instead in terms of the ability of the alloying element, beryllium, to render the oxide film more resistant to the deleterious action of the gaseous impurity, although the mechanism of the effect is not clear. A detailed investigation led to the conclusion that the deleterious impurity is probably an organic compound, perhaps a hydrocarbon. (P.C.H.)

Fabrication

Refer also to abstract 16055.

16697 (EURAEC-62) URANIUM OXIDE EXTRUSION. Quarterly Report No. 6 (January–March 1961). (Compagnie Industrielle des Combustibles Atomiques Frittés, Corbeville, par Orsay (Seine-et-Oise), France). Mar. 31, 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract 030-60-9RDF. 22p.

Extrusion of UO_2 rods with densities of 10.60 to 10.65 g/cm^3 is reported by using UO_2 powder of 6 to 7 m^2/g specific surface. These rods are 10 to 15 mm in diameter and 100 to 150 mm long and were extruded with gum tragacanth in the presence of aluminum chloride with and without isostatic pressure. Other work is reported on shaping of pastes and the effects of bonds, additives, instruments for making the pastes homogeneous, and methods of pressing. Data obtained in physical and mechanical measurements are included. (J.R.D.)

16698 (EURAEC-195) URANIUM OXIDE EXTRUSION. 4th Quarterly Report (June–September 1961) (2nd year). (Compagnie Industrielle des Combustibles Atomiques Frittés, Corbeville, par Orsay (Seine-et-Oise), France). Nov. 1961. Work Performed under United States–Euratom Joint Research and Development Program. 15p.

Densities of 10.50 g/cm^3 or greater were obtained in rod extrusions using UO_2 powder with a specific area of 8M^2/g. Extrusions also were obtained by use of gum tragacanth in the presence of aluminum chloride with tylosis or with urea under isostatic pressure. Experiments on the use of additives to increase the density of extruded rods were continued. (J.R.D.)

16699 (HW-72379) MAGNETIC FORCE WELDING SINTERED ALUMINUM POWDER MATERIALS. L. E. Mills (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1962. Contract AT(45-1)-1350. 31p.

Magnetic force resistance butt welding is an effective process for making closures on SAP fuel cladding. The resulting weld cross-sectional area is larger than the cross-sectional area of the cladding. Continuous control of all welding parameters is required to assure consistent weld quality. Weld evaluation is performed with test specimens welded and tensile tested at frequent intervals during production welding. (auth)

16700 (JPRS-13099) FORGING URANIUM. P. I. Seredin. Translated from Kuznech.-Shtampovoch. Proizvod., No. 1, 14-18(Jan. 1961). 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 12075.

16701 GAS PRESSURE BONDING. E. S. Hodge, C. B. Boyer, and F. D. Orcutt (Battelle Memorial Inst., Columbus, Ohio). Ind. Eng. Chem., 54: No. 1, 31-5(Jan. 1962).

Gas-pressure bonding methods are described that utilize autoclaves operating at pressures up to 15000 psi and temperatures up to 1600°C, to attain direct densification, cladding, and joining of components. The components are placed in a disposable container in the autoclave, and subjected to gas pressure sufficient to deform the components plastically and bring them into intimate contact for solid-state bonding, or to deform powder-metallurgy products sufficiently to cause densification. Nuclear applications of this method are emphasized. (T.F.H.)

16702 HEAT TREATMENT OF A REACTOR PRESSURE VESSEL. Instr. Pract., 15: 1253-4(Oct. 1961).

A 70-ft-diameter reactor was heat treated for relieving stress. Temperatures were measured by thermocouples at some 400 points. Approximately $^3/_4$ of the thermocouples were connected to a digital typewriter recording system which presented the temperatures in the form of a printed list, while the remaining $^1/_4$ were connected to 6 strip-chart recorders. Temperature readings were plotted in graph form. The temperature rise in the treatment was limited to less than 5°C/hr, and on this basis it took approximately 7 days for the pressure vessel to reach the stress-relieving temperature of 550°C at which it was soaked for 12 hr. After the soaking period the vessel was left to cool for 9 days before removing the thermal insulation. The absence of any faults in the pressure vessel or its contents indicated that the stress-relieving was entirely successful. (M.C.G.)

16703 HIGH TEMPERATURE, CORROSION RESISTANT FLAME SPRAYED PROTECTIVE COATINGS MADE FROM REFRACTORY MATERIALS. H. S. Ingham (Metco, Inc., Westbury, N. Y.). Materials Protect., 1: 74-8(Jan. 1962).

Descriptions are given of combustion flame and plasma flame type spray guns used to apply refractory materials as protective coatings to resist corrosion, abrasion, and high temperatures. A comparison is given of three types of flame spraying processes: combustion powder spraying, combustion rod spraying, and plasma flame spraying. Some recent research and development on the coating materials is outlined and applications of the three types of spraying processes are given. (P.C.H.)

16704 A METHOD OF AND APPARATUS FOR MANUFACTURING HELICALLY FINNED TUBING. Ferdinand Busse (to Peco Elektrische Schweissmaschinenfabrik Rudolf Bocks). British Patent 893,701. Apr. 11, 1962.

An apparatus is described for manufacture of helically finned tubing for use, e.g., in heat exchangers in gas-cooled atomic power plants. In the operation of the apparatus, at least one U-sectioned strip constituting the fins is wound helically onto a tube and is bonded to the tube surface by electric resistance seam welding. (D.L.C.)

Properties and Structure

Refer also to abstracts 16045, 16046, 16047, 16049, 16050, 16051, 16053, 16054, and 16057.

16705 (62-GC-206) LOW-TEMPERATURE BRITTLENESS OF REFRACTORY METALS. Final Report. H. W. Schadler and J. R. Low, Jr. (General Electric Co. Research Lab., Schenectady, N. Y.). Apr. 1962. Contract Nonr-2614(00). 111p.

Research on the flow behavior of W is reported. Work is described in the production of high-purity material, deformation and mechanical properties of W single crystals, and behavior of individual dislocations. Information is also included on recrystallization characteristics of cold-worked W single crystals and on the crystallography of twins in Mo–Re single crystals. (J.R.D.)

16706 (AD-264434) EVALUATION OF THE PRODUCIBILITY OF TWO NEW TITANIUM BASE SHEET ALLOYS, Ti–7Al–12Zr AND Ti–5Al–5Zr–5Sn. Bi-monthly Report No. 8, May 1, 1961–June 30, 1961. M. Scott and T. Vretas (Republic Steel Corp. Titanium Research Lab., Canton, Ohio). July 18, 1961. Contract NOas 60-6035-C. 11p.

Additional work was performed on Ti–7Al–12Zr alloys. Testing of finished mill processed 0.020, 0.040, 0.060, and 0.080 in. gage sheet showed the sheets to be quite brittle. Additional total gage removal varying from 0.005 to 0.026 in. from these sheets was beneficial in making more ductile sheets but did not restore the original ductility as indicated by bend test results. These data suggest the existence of metallurgical instability in the alloy arising from mill processing. Mill processing of 0.030 and 0.050 in. gage sheet product, Ti–5Al–5Zr–5Sn, Heat XT-70029 is in progress. Tensile test, bend test, and hydrogen content data were developed for sheets ready for vacuum annealing. Additional total gage removal of 0.006 in. is necessary for the sheets before vacuum annealing. (auth)

16707 (AD-265319) HIGH TEMPERATURE RADIATION RESISTANT MATERIALS. Progress Report No. 3, February 1, 1961–April 30, 1961. C. I. Carr and R. Miller (United States Rubber Co., Wayne, N. J.). May 17, 1961. Contract NObs-84025. 13p.

Stress relaxation studies for ethylene propylene rubbers (EPR) containing Sb_2O_3 and Hypalon 40 were carried out. A mixture of dialkyl hydrogen phosphite and a phenol antioxidant did not protect EPR against air oxidation. Adhesion to brass and steel wire was improved with this protective system. The addition of Sb_2O_3 and Hypalon to EPR did not alter its aging characteristics in oil and tricresyl phosphate. Polyethylene and EPR with low levels of carbon black, containing Sb_2O_3 and a chlorinated paraffin exhibited good green and aged electrical properties. (auth)

16708 (AD-266128) THERMOELECTRIC MATERIALS FOR POWER CONVERSION. Quarterly Progress Report No. 8 (Final Report), April 1, 1959–January 31, 1961. F. D. Rosi and E. F. Hockings, eds. (Radio Corp. of America. RCA Labs., Princeton, N. J.). Feb. 15, 1961. Contract NOBS-77057. 92p.

Materials research on Bi telluride alloys, ternary compounds, silicides, and sulfides is described. The measurements of thermal diffusivities of semiconductors at high temperatures are described with efficiency measurements on power generating thermocouples. Measurements of the temperature dependence of thermoelectric properties on a number of solid solution alloy systems showed that solid solution alloys of Bi_2Te_3 with Bi_2Se_3, Sb_2Te_3 and Sb_2Se_3 provided the best p- and n-type material for thermocouple operation in the temperature range 25 to 250°C. A large number of ternary compound semiconductors having the cubic structure were synthesized and those, such as $AgSbTe_2$, with the rock salt structure are characterized by low lattice thermal conductivities. $AgSbTe_2$ and its alloys with GeTe provided p-type materials useful for power generation in the range 250 to 550°C. (auth)

16709 (AD-267010) THERMIONIC EMITTER MATERIALS RESEARCH PROGRAM. Quarterly Report No. 1, July 1, 1961–September 30, 1961. (Thermo Electron Engineering Corp., Waltham, Mass.). Contract NONR-3563(00). 115p. (TEE-4015-1)

Studies were made of refractory metals as emitter materials for thermionic converters. Two diodes were tested. One used a tantalum emitter and a molybdenum collector, the other used molybdenum for both. Current-voltage (I-V) characteristics were determined. Under certain conditions the I-V curves exhibited two branches. Each branch approached a constant current value as output voltage was reduced. This behavior led to the association of an apparent work function with each constant current value. A technique was developed for measuring the ion current in the experimental diode. Methods were also developed to determine electron cooling and heat conduction by cesium vapor. (M.C.G.)

16710 (AD-267028) RESEARCH ON MATERIALS, PROCESSES, AND DEVICES RELATED TO ENERGY CONVERSION. Semiannual Technical Summary Report No. 1. (Massachusetts Inst. of Tech., Cambridge. School of Engineering). Sept. 30, 1961. Contract Nonr-1841(78). 95p.

Research was carried out on thermoelectric materials, processes, and devices including: a graded-gap detector using the HgTeCdTe system, four-probe correction factors for wedge-shaped geometries, and a thermal-photovoltaic energy converter using germanium. Refractory thermoelectric materials of the Gd–Se– and Ce–Se systems were studied. High-temperature thermionic materials of the systems Y + Hf, Nb, Cr, Re, and Rh were investigated along with Mo plus ThO_2, IaO_2, and BaO. Thermionic energy converter studies were made of emitter materials. Superconducting materials of niobium–tin alloys, superconducting solenoids using niobium–tin materials, and fuel cells were evaluated. (M.C.G.)

16711 (AERE-M-1000) SOME FACTORS AFFECTING THE HARDENING CAUSED BY GAS BUBBLES. M. J. Makin (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Feb. 1962. 9p.

A discussion of the difficulties and limitations of the semicircular dislocation model previously suggested to account for the hardening of crystalline solids by gas bubbles is presented. It is concluded that the model as proposed needs extensive modification when the bubbles are very small. (auth)

16712 (ARF-2231-3) PILOT EVALUATION OF VANADIUM ALLOYS. Bimonthly Report No. 3, January 18, 1962–March 17, 1962. B. R. Rajala and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Apr. 13, 1962. Contract NOw 61-0101-c. 13p.

Compositions based upon V–1 wt % Ti–60 wt % Nb and V–1 wt % Hf–60 wt % Nb complexed with 0.05 to 0.1 wt % oxygen and/or nitrogen were evaluated for fabricability. The materials containing less than 0.06 wt % deliberate interstitial additions could be rendered to sheet by warm (1000°F) working; compositions with greater amounts could not be fabricated even by hot working in the temperature range of 1800 to 2400°F. Tensile evaluations conducted on V–5 wt % Ti–20 wt % Nb and V–5 wt % Ti–20 wt % Nb–0.05 wt % O at 2000°F in helium showed that the addition of 0.05 wt % oxygen resulted in approximately a 40% increase in strength. A large number of vanadium-base alloys were also evaluated for tensile strength at 2400°F. The highest 2400°F ultimate tensile strength measured was 12,700 psi for the alloy V–1 wt % Ti–60 wt % Nb, a value comparable to that measured for several commercial and experimental niobium-base alloys. In addition, several compositions were equally as strong on a density-corrected basis. (auth)

16713 (AROD-431:44) THE INFLUENCE OF ELECTRON INTERACTIONS ON SOME PROPERTIES OF METALS. Technical Report No. 28 [on] THEORETICAL RESEARCH ON CONDUCTION OF ELECTRICITY. Seth David Silverstein (Illinois. Univ., Urbana). Jan. 1962. Contract DA-11-022-ORD-1001. 162p.

A detailed extension of the Nozieres-Pines momentum transfer interpolation procedure to the calculation of the low temperature specific heat and the static paramagnetic spin susceptibility for the region of actual metallic densities are considered. Numerical results are given for the case of alkali metals. The formal theory of paramagnetic response to time-dependent inhomogeneous magnetic fields is included, and magnetic resonance experiments are discussed from which information may be obtained concerning the nature of the response. A summary is given of the application of Green's functions to the electron gas problem. From first principles, the nature of the spectral distribution functions for an interacting thermodynamic system is derived. (auth)

16714 (ASD-TR-61-87) STRUCTURAL RESPONSE OF BERYLLIUM SHEET PRODUCED BY THREE FABRICATION METHODS. Final Report, February 1960 to March 1961. C. J. Giemza (Martin Co., Baltimore). June 1961. Contract AF33(600)-40648. 47p.

Hot-pressed, hot-upset and hot cross-rolled beryllium sheet was examined to assess their differences and advantages from a structural design viewpoint. Tension, notch tension, compression, bend ductility, and box-beam tests, with the main emphasis on factors which tend to embrittle beryllium, were conducted. The results showed that a hot cross-rolled beryllium sheet exhibits both high strength and high elongation in tensile tests but is relatively brittle when, as in bending, the stress is complex. Hot-pressed beryllium sheet, which is low in tensile strength and elongation, demonstrates an excellent capacity for accommodating complex stresses in bending without fracture. The hot-upset beryllium sheet exhibited the best characteristics possessed by both hot-pressed and hot cross-rolled beryllium, though to a lesser degree than the optimum of each. The differences in mechanical behavior among the three groups are apparently a function of the degree of preferred orientation. However, the amounts of impurity elements which were reported could have contributed significantly to the embrittlement of the hot-pressed and hot cross-rolled beryllium sheet. The data are presented as trend curves and, when appropriate, in tabular form. (auth)

16715 (CAL-PI-1273-M-10) AN INVESTIGATION OF THE THEORETICAL AND PRACTICAL ASPECTS OF THE THERMAL EXPANSION OF CERAMIC MATERIALS. Quarterly Progress Report, January 1, 1961–March 31, 1961. W. Richard Brown and Henry P. Kirchner (Cornell Aeronautical Lab., Inc., Buffalo). Mar. 31, 1961. Contract NOrd-18419. 20p. (AD-264974)

The thermal expansion coefficients of 4 members of the homologous series of cubic rare earth oxides were measured, plotted against the openness ratios, and the molar volumes calculated for each oxide. Thermal expansion coefficients appeared to increase with decreasing openness ratio or molar volume in going from Sc_2O_3 to the true rare earth oxides, but within the sub-series of true rare earth oxides (Sm_2O_3 to Lu_2O_3), the expansion coefficient appeared to be nearly constant. Procedures used in estimating the precision and accuracy of expansion coefficient determination by x-ray diffraction were discussed. With Cu radiation, the estimated accuracy for most of the materials of interest is $\pm 1.3 \times 10^{-7}/°C$ or less, over the range 25 to 1000°C. With Cr radiation, the estimated accuracy is $\pm 1.4 \times 10^{-7}/°C$, over the range 25 to 1200°C, and $\pm 1.7 \times 10^{-7}/°C$ or less, over the range 25 to 1000°C. (auth)

16716 (CNLM-2166) PRODUCIBILITY OF AN ALLOY OF COLUMBIUM WITH ONE PERCENT ZIRCONIUM. L. M. Raring (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Dec. 4, 1959. Contract [AT(11-1)-229]. 16p.

Proven mineral resources show that niobium is the most abundant of the refractory metals and extraction capacity is adequate to meet foreseeable requirements. Approximately four tons of Nb-1% Zr alloy were melted, forged, drawn, and rolled to produce various mill forms and relatively large die impression forgings. It was demonstrated that the Nb-1% Zr alloy is readily amenable to melting, primary working, and secondary working using standard equipment available in the specialty steel and nickel alloy industries. In general, the hot malleability of the alloy is significantly better than that of the more refractory nickel base high temperature alloys and is comparable to the stainless steels. Methods were successfully developed to protect the alloy against contamination during hot working. Cold fabricability proved to be outstanding. Reductions up to 90% were achieved during cold rolling of sheet with no intermediate stress relief or annealing treatment. Tube drawing reductions up to 50% were normal with no intermediate annealing. Over-all, the cold workability of this alloy was superior to that of the stainless steels. There was no problem of embrittlement over the full range of working temperatures which were used during the course of this work, namely from room temperature to 2350°F. Welding of the Nb-1% Zr alloy was developed to the stage where many thousands of welds are performed in a routine manner with insignificant rejections. (auth)

16717 (DC-58-11-114) STRUCTURE OF THE COMPOUNDS $CrBe_{12}$, VBe_{12}, AND $NbBe_{12}$. P. I. Kripyakevich and E. I. Gladyshevskii (Ye. I. Gladyshevskiy). Compiled by J. H. Guill (General Electric Co. Aircraft Nuclear

Propulsion Dept., Cincinnati). Translated from Doklady Akad. Nauk S.S.S.R., 104: 82-4(1955). 10p.

A series of intermetallic compounds of Cr, Nb, and V with Be were prepared. Their x-ray diffraction powder patterns indicated compositions identical with respect to each other and sharply differentiated from the x-ray patterns of Be and the XBe-type compounds. It was hypothesized that the compounds are of the type XBe_{12}. The number of atoms in the unit cell and the observed intensities of the lines agreed with this hypothesis. The constants of the elementary cell of $CrBe_{12}$, VBe_{12}, and $NbBe_{12}$ are given along with calculations based on interatomic distances. (M.C.G.)

16718 (DF-59-SL-314) AGING REACTIONS IN RENÉ 41. H. J. Beattie (General Electric Co. Materials and Processes Lab., Schenectady, N. Y.). May 15, 1959. 50p.

Variations in the structure of the alloy were determined as a function of quenching from 1800 to 2200°F and aging quenched specimens from 1300 to 1700°F for times up to 1000 hours. Impact resistance and hardnesses were measured and optical, electron, and x-ray metallography were used in the structure investigation. The solution temperature of γ' was between 1900 and 1950°F, while that of K_1 ("M_6C") was about 2150°F. The γ' precipitated on air-cooling from above 1950°F; its formation was retarded if K_1 was in solution. Aging up to 1700°F caused an apparently coherent nucleation of $M_{23}C_6$ at grain boundaries, but cellular growth was arrested. The resulting embrittlement was severe when K_1 was initially in solution. The hardness was relatively stable, as general nucleation of μ phase occurred with over-aging of γ'. The γ'-coherency lattice strain was similar to those of M-252 and Udimet 500, but was of opposite sign. Aging after water-quenching from 2150°F is shown graphically. (auth)

16719 (EURAEC-137) ON THE CONSTITUTION OF ZIRCONIUM–NIOBIUM ALLOYS. Special Report No. 1. H. Richter, P. Wincierz, K. Anderko, and U. Zwicker (Metallgesellschaft A. G., Frankfurt am Main). Aug. 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract 009-60-4RDA. 32p.

An investigation of the Nb–Zr system revealed that even when iodide zirconium with 99.9% purity was used, the oxygen content of the smelted alloys imparts a decidedly ternary character to the constitution pattern. The result is that the monotectoid point of the binary system extends over a transformation range which, for alloys made of iodide zirconium, spreads over some 100°C and for those made of sponge zirconium, over more than 200°C. (auth)

16720 (EURAEC-213) ELECTRICAL RESISTIVITY MEASUREMENTS OF SINTERED UO_2. Special Report No. 2. (France. Commissariat à l'Énergie Atomique, Paris). Oct. 1961. Work performed under United States-Euratom Joint Research and Development Program. 33p.

The electrical resistivities of sintered UO_2 bodies were measured at temperature to 600°C. The effect of powder preparation, compacting pressure, sintering temperature, density, O content, and oxide additions on the electrical properties of the material were investigated. Suggestions on how the experimental findings may be related to factors which determine the sinterability of the oxide are included. (J.R.D.)

16721 (GAMD-1233) VAPOR TRANSPORT OF URANIUM FROM UC_2–C COMPACTS. D. V. Ragone and L. R. Zumwalt (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Feb. 5, 1960. Contract AT(04-3)-314. 9p.

Calculations were made on the rate of vapor transport of uranium from UC_2 in equilibrium with graphite. Three types of vapor transport were considered: an evaporation from a surface into a vacuum where the rate of evaporation is determined by the Langmuir Equation; a diffusional process from the surface across a gap filled with helium at 20 atm; and vapor phase diffusion through the graphite matrix of fuel compacts. It was concluded that the first or second process will lead to an unacceptable loss of uranium. On the other hand, vapor phase diffusion through graphite matrices would appear to give low losses and should not be an important mechanism for the transport of uranium to the surface of fuel compacts. However, there is the possibility of other migration mechanisms and substantial uranium losses from compacts at hot spots. (auth)

16722 (LA-2611) HIGH TEMPERATURE VAPORIZATION BEHAVIOR AND THERMODYNAMIC PROPERTIES OF HAFNIUM DIBORIDE. Milton C. Krupka (Los Alamos Scientific Lab., N. Mex.). Feb. 1962. Contract W-7405-Eng-36. 149p.

Vaporization of hafnium diboride was studied in a tungsten effusion cell over the temperature range from 2175 to 2500°K. A low-melting eutectic at 2520°K prevented the use of the effusion cell technique at high temperatures. An ultra-high vacuum apparatus, capable of producing vacuums of the order of 1×10^{-12} atm or better and within which the final series of vapor pressure measurements was made, was designed and constructed. The effect of a high background pressure in producing species more volatile than the ones under investigation was considered to be reduced to negligible proportions. Hafnium diboride vaporized congruently at a nonstoichiometric composition of $HfB_{1.955\pm0.010}$. This composition was very nearly constant up to and including a temperature of 2730°K. Hafnium diboride samples studied at temperatures above this temperature (in the vicinity of 3000°K) showed a singularly different behavior. The Motzfeldt treatment was considered for the determination of both the vaporization coefficient and the equilibrium pressure. The data were used to obtain a vaporization coefficient of 0.098 ± 0.010 and an equilibrium partial pressure of hafnium over $HfB_{1.955}$ at 2500°K of 3.1×10^{-7} atm ± 10%. Analysis of the data indicated that hafnium diboride vaporizes predominantly according to the equation $HfB_{1.955}(s) = Hf(g) + 1.955\ B(g)$ over the temperature range investigated. A Third Law standard heat of vaporization, ΔH_0°, of 477.8 ± 5.5 kcal/mole and an estimated entropy change at 2000°K, ΔS_{2000}°, equal to 100.3 e.u. were determined for this reaction. A value of 142 ± 7 kcal/mole was deduced for the heat of vaporization of hafnium metal from data obtained in this research. (auth)

16723 (NMI-7211) A STUDY OF FACTORS AFFECTING THE DUCTILITY OF TUBULAR ZIRCALOY-CLAD FUEL ELEMENTS. This Program was conducted during the period January to April 1960. H. M. Green, A. M. White, and S. Isserow (Nuclear Metals, Inc., Concord, Mass.). Mar. 22, 1962. Contract AT(30-1)-1565. 40p.

A mechanical burst test was used to determine the effect of several factors that might affect the ductility of Zircaloy cladding of a swelling fuel. Factors other than the ductility of the Zircaloy cladding were found to limit the ductility of composites containing cores of unalloyed uranium or U–2 wt % Zr. (auth)

16724 (NMI-9238) REFRACTORY METALS PHASE DIAGRAMS. Quarterly Progress Report for the Period October 1, 1961 to January 1, 1962. E. J. Rapperport (Nuclear Metals, Inc., Concord, Mass.). Mar. 28, 1962. Contract AF33(616)-7157. 7p.

Approximately 20 ternary Zr–Ti–Mo alloys were prepared by arc-melting buttons of the pure metals in a water-cooled cooper hearth using a non-consumable electrode. Phase identification by x-ray diffraction was possible for the Ta–W–Zr alloy. Initial alloys were prepared in the binary Mo–Ir and Nb–Ru systems. Experimental work on the Ta–Rh and Ta–Ir systems was finished. The work on the constituent binary system Re–Hf was completed, and the extent of the phases was determined. (M.C.G.)

16725 (NMI-9517) BERYLLIUM RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report to Aeronautical Systems Division for the Period October 1, 1961 through December 31, 1961. S. H. Gelles (Nuclear Metals, Inc., Concord Mass.). Apr. 16, 1962. Contract AF33(616)-7065. 30p.

Plans for a Be research and development program are described. Work being conducted on brittleness in Be is detailed as well as work in progress on the production and evaluation of high purity Be. (auth)

16726 (NP-11311) RESEARCH ON PHYSICAL AND CHEMICAL PRINCIPLES AFFECTING HIGH TEMPERATURE MATERIALS FOR ROCKET NOZZLES. Semiannual Progress Report, July 1, 1961 to December 31, 1961. Robert Lowrie (Union Carbide Corp. Research Inst., Tarrytown, N. Y. and Union Carbide Corp. Parma Research Center, Ohio). Dec. 31, 1961. Contract DA-30-069-ORD-2787. 78p.

A semiquantitative study is made of the erosion or refractory materials by hot gases such as are encountered in rocket nozzles. The materials studied include TiB_2, ZrB_2, NbB_2, TaB_2, TiC, ZrC, NbC, TaC, W, and graphite, and the gases include CO, CO_2, H_2, HCl, BF_3, and CO–H_2O, CO–CO_2, and H_2–H_2O mixtures. The reactions of H_2 with graphite and TiC at 1800 to 2500°C are studied. The vaporization of ZrB_2 is studied near 2400°K. The spectra of molecular species of C (e.g., C and C_2) in matrices of Ar, Xe, and Ne are measured. The dynamic elastic constants of single-crystal W, ZrC, and TiC, and of polycrystalline TiC and graphite, are determined at 27 to 1800°C. X-ray measurements are made of the thermal expansion and atomic vibration amplitudes of TiC at 25 to 1700°C. The electric conductivity and Hall coefficient are found for single-crystal TiC and for polycrystalline ZrC and TiC, at 77 to 350°K. The creep, optical density, and activation energy of MgO are measured, as a function of the heat treatment, at 1700 to 2000°K. The thermal conductivity of graphitized foam is measured at 1000 to 2400°K. (T.F.H.)

16727 (NP-11553) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Virginia L. Frazier, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Feb. 1962. Contract AF33(616)-7747. 47p.

An abstract bibliography of selected articles is presented on high-strength alloys, engineering steels, stainless steels, light metals, non-metallics, refractory metals, and coatings. (About 75 references) (J.R.D.)

16728 (ORNL-3250(Pt.I)) THE STRAIN-FATIGUE PROPERTIES OF INCONEL. PART I. GENERAL CONSIDERATIONS. R. W. Swindeman (Oak Ridge National Lab., Tenn.). Apr. 12, 1962. Contract W-7405-Eng-26. 19p.

Several equations which may be used to describe strain-fatigue behavior are discussed in regard to their applicability to thermal-fatigue problems. The plastic-strain-fatigue curve is shown to be the most realistic relationship for evaluating service life in high-temperature thermal-fatigue problems. (auth)

16729 (ORNL-3250(Pt.II)) STRAIN-FATIGUE PROPERTIES OF INCONEL. PART II. ISOTHERMAL TESTS WITH CONSTANT HOLD TIME. R. W. Swindeman (Oak Ridge National Lab., Tenn.). Apr. 12, 1962. Contract W-7405-Eng-26. 35p.

The results of an experimental investigation of the isothermal strain-fatigue properties of Inconel at temperatures up to 1650°F are presented showing the effects of temperature, cyclic frequency, grain size, and environment. An equation of the form $\epsilon_p N_f^{\alpha} = c$ was found to adequately represent the properties of the material. The value for the constant α increases above the previously proposed value of $\frac{1}{2}$ with increasing temperature and decreasing cyclic frequency, whereas c increases with temperature but decreases with decreasing cyclic frequency. The values of α and c obtained were 0.5 to 0.96 and 0.48 to 1.03, respectively. Although the fused fluoride salt environment was corrosive to Inconel, its effect on the fatigue properties at 1500°F was insignificant when compared with the properties obtained in Ar. (auth)

16730 (ORO-543) CHARACTERIZATION OF UO_2 POWDERS. Third Quarterly Report, April 10, 1961–July 10, 1961. James F. Carpenter, Carl W. Kuhlman, and Robert A. Nelson (United Nuclear Corp. Chemicals Div., Hematite, Mo.). Contract AT(40-1)-2699. 19p.

Twelve different UO_2 powders are being evaluated on the basis of physical and chemical properties. A correlation between the UO_2 powder characteristics and powder sinterability is being sought. Investigations included characterization of the UO_2 powders by means of particle size distribution, oxidation behavior, and infrared transmission studies. The sinterability of the powders could be estimated with a fair degree of certainty from particle-size distribution curves obtained for the powders. A simple means of studying the oxidation behavior of UO_2 powders by means of hot-stage microscopy is presented. Infrared transmission procedures were used to determine the amount of U_3O_8 in UO_2 samples. The limit of detectability is 2%. Infrared transmission curves in the region of 2 to 15 microns showed an apparent, but unexplained, correlation with the sintering potential of the powders. (auth)

16731 (PAN-246/I-B) NOTE ON THE CUBIC-HEXAGONAL TRANSFORMATION IN COBALT. A. Modrzejewski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 6p.

The cubic-hexagonal transformation of Co in close-packed planes was confirmed in single crystal growth experiments. Observations of Co crystal structure are included. (J.R.D.)

16732 (TIM-312) FINAL REPORT ON THE BERYLLIUM THERMAL CYCLE TESTS. W. L. Stoner (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Oct. 1, 1956. Contract [AT(11-1)-229]. 11p.

Tests were carried out to determine the effect of cyclic thermal stresses on specimens made of type QMV beryllium. The results of the tests indicated that the density of the material and the surface preparation of the specimens greatly affect the ability of the specimens to withstand thermal cycles and stresses such as were imposed in the tests. It was concluded that for specimens free of true porosity with properly prepared surfaces, operating maximum temperatures of 1350°F and ΔT's of 75°F would not be excessive. By lowering the maximum temperature to 1200°F it is believed that ΔT's as high as 120°F may be used. At these conditions slight distortion and cracking may take place, but actual breaking up of the parts would not be expected. The tests also indicated that milled finishes give better results than ground finishes. Acid etching after machining gave further improvement. (M.C.G.)

16733 (WADD-TR-60-581(Pt.II)) THERMAL PROPERTIES OF REFRACTORY MATERIALS. J. A. Cape and R. E. Taylor (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 1961. Contract AF33(616)-6794. 27p. (AD-264228)

Refinements in the transient thermal property apparatus are described. With these modifications, the apparatus was used to determine the thermal diffusivity of WB from about 1300 to 1600°C. The measured values increase from about 0.054 to 0.058 over this temperature interval. The techniques and apparatus for measuring the specific heat of brittle conductors by pulse heating are also described. Resistivity and specific heat data for uranium silicide of several compositions are reported. The resistivity and specific heat increased with increasing silicon content. For uranium silicide containing 3.8% silicon, the resistivity increased from 56 micro-ohm-cm at 0°C to 75 micro-ohm-cm at 750°C and for uranium silicide containing 5.9% silicon, the resistivity increased from 81 micro-ohm-cm at 0°C to 111 micro-ohm-cm at 800°C. The specific heat for the 3.8% silicon material is given by $c_p = 3.16 \times 10^{-6}\ T + 0.0412$ cal/gm-°C from 50 to 430°C, and for the 5.8% silicon material, $c_p = 16.1 \times 10^{-6}\ T + 0.0455$ cal/gm-°C from 50 to 715°C, where T is in °C. The thermal conductivity of TiC was measured at 400 to 1200°C. The steady-state radial heat flow method was used. The conductivity varies linearly from 0.088 cal/sec-cm-°C at 500°C to 0.109 cal/sec-cm-°C at 1100°C. These results are in marked contrast to values reported in the literature. (auth)

16734 (WCAP-1655) AN INVESTIGATION OF MIXED VALENCE THERMOELECTRIC MATERIALS. J. C. Danko, G. R. Kilp, and H. M. Ferrari (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Oct. 1960. Contract AT(30-3)-500. 54p.

Elementary thermoelectric theory as applied to the narrow band semiconductor is discussed. Several general rules designed to guide the selection of materials during development of new or improved thermoelectric materials are given. Potential thermoelectric materials investigated experimentally are: $Li_xNi_{1-x}O$, CeS_x, $M_xU_{1-x}O_2$ ($M = Na^+$, Ca^{2+}, Y^{3+}, Tl^{3+}, Ta^{5+}, W^{6+}), $Na_xBa_{1-x}UO_3$, $La_xBa_{1-x}TiO_3$, and $Y_xCa_{1-x}VO_3$. Variables studied in the $Li_xNi_{1-x}O$ system included concentration of doping agent, pelletizing operations, sintering time and temperature, and the effect of MgO additions on thermal conductivity. It was concluded that the best LiNiO compounds approach a thermocouple efficiency of 7% at 1100°C, but would have a limited temperature range of operation (800 to 1100°C). The CeS_x system showed much promise. A thermocouple efficiency of 12% was achieved at temperatures up to 1100°C. The UO_2 compounds investigated displayed consistently low thermoelectric efficiencies. Several possible approaches to better materials are suggested. Of the "perovskite" type compounds studied ($Na_xBa_{1-x}UO_3$, $La_xBa_{1-x}TiO_3$, $Y_xCa_{1-x}VO_3$), the one which showed the greatest promise was $La_xBa_{1-x}TiO_3$. Insufficient work was done on the other systems to warrant definite conclusions. (auth)

16735 (AEC-tr-5028) ELECTRON MICROSCOPE STUDY OF POROSITIES, CARBON INCLUSIONS AND DISLOCATIONS IN HOT-PRESSED BERYLLIUM OXIDE. Andre Bisson and Henri Frisby (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Saclay). Translated from Report DM/949. Jan. 1961. 24p.

Also published in J. Nuclear Materials, 4: 133-42(July 1961).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 31232.

16736 (UCRL-Trans-791(L)) CONTRIBUTION TO THE STUDY OF THE PROPERTIES OF ZIRCONIA BASED SOLID REFRACTORY SOLUTIONS AND THE STABILIZATION OF CUBIC ZIRCONIA. H. J. Stoecker. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Ann. chim. (Paris) (13), 5: 1459-1502(1960). 55p.

Results are presented of a study on the structural modifications observed in zirconia caused by dissolving small quantities of foreign oxides. The addition of bivalent or trivalent metal oxides causes the evolution of the quadratic lattice in pure zirconia toward a cubic lattice. Information is included on stabilization of cubic zirconia and systems formed by zirconia with oxides of trivalent metals. (J.R.D.)

16737 EFFECTS OF COLUMBIUM ON THE PROPERTIES OF ALUMINUM-KILLED, MEDIUM-CARBON STEEL. E. E. Fletcher (Battelle Memorial Inst., Columbus, Ohio), A. R. Elsea, and E. C. Bain. Am. Soc. Metals, Trans. Quart., 54: 1-11(Mar. 1961).

The effects of adding 0.012, 0.09, 0.17, and 0.35% Nb to a 0.35% carbon steel were investigated. The study of response to heat treatment included determining the effects of Nb on the grain-growth, carbide–solution, hardenability, and tempering characteristics of this heat-treatable steel. Nb was found to provide a strong resistance to grain growth at elevated temperatures. Because Nb carbide goes into solution very slowly, it was not practicable to take it all into solution for steel containing 0.09% and more Nb. For austenitizing conditions that did not coarsen the grain, increasing the Nb content reduced hardenability. However, the hardenability increased with increasing grain size, as expected. The addition of Nb raised the yield and tensile strengths by as much as 8,200 psi without loss in elongation or reduction in area. The greatest strength was obtained with a Nb content of only 0.012%. For all but one condition of heat treatment studied, Nb either lowered the notched-bar impact-transition temperature or had no appreciable effect on it. (auth)

16738 THE NONSTOICHIOMETRY OF URANIUM OXIDES. Paul Gerdanian and Maurice Dode. Compt. rend., 254: 1005-7(Feb. 5, 1962). (In French)

The variations of the partial molar entropy of the oxygen in the oxides UO_{2+x} where $O < x < 0.20$ were determined by considering the accumulation of interstitial oxygen and the localization of positive holes. (tr-auth)

16739 STRUCTURE PECULIARITIES OF A HIGH PURITY STAINLESS STEEL OF THE 18/8 TYPE. Phu Sy Uy, Jean Montuelle, and Jean Talbot (Centre National de la Recherche Scientifique, [Paris]). Compt. rend., 254: 1058-60(Feb. 5, 1962). (In French)

During research on metals and alloys of high purity, the new properties of a stainless steel of the 18/8 type, prepared from pure metals, were studied. This problem was investigated under two aspects: that of the micrographic structure (which is the subject of the present article) and that of the chemical and electrochemical properties. (tr-auth)

16740 CONTRIBUTION TO THE STUDY OF THE SEGREGATION OF IMPURITIES IN BERYLLIUM OF COMMERCIAL PURITY. Yves Adda, Noël Azam, Gérard Donze, José Mallen, Françoise Maurice, and Michel Weisz (Centre d'Études Nucléaires, [Saclay, France]). Compt. rend., 254: 1952-4(Feb. 5, 1962). (In French)

It is shown, using commercial beryllium, that aluminum, a slightly soluble impurity, dispersed in the form of a liquid phase beginning at 650°C plays an important role in the segregation of other impurities. These are eliminated from the beryllium matrix by selective dissolution in the liquid phase during thermal treatments made between 650 and 800°C. (tr-auth)

16741 THERMOPHYSICAL PROPERTIES OF MOLTEN METALS. Yu. P. Os'minin (All-Union Correspondence Power Engineering Inst., Moscow). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 5: No. 2, 108-12(Feb. 1962). (In Russian)

The relationship between temperature and heat conduction, temperature conduction, heat capacity, and surface tension of liquid metals is studied. Dimensionless relationships are obtained for tin, bismuth, mercury, sodium, and potassium. According to generalized equations, the values of physical parameters are calculated for tin, bismuth, and sodium at high temperatures. (auth)

16742 MAGNETIC STUDIES OF SOME INTERMETALLIC COMPOUNDS BETWEEN COBALT AND THE LANTHANIDE ELEMENTS. L. V. Cherry and W. E. Wallace (Univ. of Pittsburgh). J. Appl. Phys., 33: 1515-17(Apr. 1962).

Thermomagnetic studies of intermetallic compounds having the stoichiometry ACo_5, in which A represents yttrium or a lanthanide element, were extended to liquid helium temperatures. At applied magnetic fields of 2600 and 7200 oerstels, anomalies not appearing at high fields were observed in the behavior of $PrCo_5$ and $NdCo_5$. These anomalies are an apparent second (low-temperature) Curie point at about 126°K in $PrCo_5$ and a maximum in the thermomagnetic curve of $NdCo_5$ in the vicinity of 270°K. The data obtained for other ACo_5 compounds are consistent with those reported recently by Nesbitt et al. Results for $PrCo_5$ and $NdCo_5$ indicate ferromagnetic coupling of the cobalt moments on cooling below 910 and 925°K, respectively, while in each case at low fields, the lanthanide moments remain disordered. With $PrCo_5$ the data indicate ferromagnetic coupling of the Pr and Co moments below 126°K. Data for $NdCo_5$ suggest that on cooling, a similar type of coupling develops at about 270°K, but this is almost immediately superseded by antiferromagnetic coupling of the Nd moments with one another at lower temperatures. (auth)

16743 EVIDENCE FOR A NEW PHASE BOUNDARY IN THE FERROELECTRIC LEAD ZIRCONATE-LEAD TITANATE SYSTEM. Harold M. Barnett (Sandia Corp., Albuquerque, N. Mex.). J. Appl. Phys., 33: 1606(Apr. 1962).

Electrical studies of materials in the rhombohedral region of the lead zirconate-lead titanate system were conducted. A transition occurring between two ferroelectric states and characterized by electrical and physical anomalies was indicated by a hysteresis anomaly occurring in dissipation and dielectric constant measurements as functions of temperature and effects on the planar coupling coefficient and the resistivity. A phase diagram of the system with 1 wt % NbO_5 is presented. (L.N.N.)

16744 ON INTERMEDIATE PHASES IN LANTHANON–MANGANESE SYSTEMS. L. V. Cherry and W. E. Wallace (Univ. of Pittsburgh). J. Appl. Phys., 33: 1619-20(Apr. 1962).

Alloys containing 75 to 90 at. % Mn were studied. Results suggest an intermediate phase AMn_4, in which A represents yttrium or a rare earth, as the basic stoichiometry. Data from saturation magnetization of A-Mn alloys at 4.2°K and thermomagnetic behavior of AMn_4 and $GdMn_5$ at 7240 oersteds are presented in tabular and graphical forms, respectively. (L.N.N.)

16745 METALLIC OXIDE PHASES OF NIOBIUM AND TANTALUM. II. METALLOGRAPHIC STUDIES. N. Norman, P. Kofstad, and O. J. Krudtaa (Central Inst. for Industrial Research, Blindern, Oslo). J. Less-Common Metals, 4: 124-37(Apr. 1962). (In English)

Metallographic studies on polished and etched specimens show that NbO_x and TaO_y cannot be distinguished from the metal phase. The isomorphous suboxides NbO_z and TaO_z form platelets in the metal. It appears that nucleation of the latter two suboxides is favored at sites of strain or imperfections in the metals. (auth)

16746 ANALYSIS OF SPECIFIC HEATS OF CERIUM, NEODYMIUM, AND SAMARIUM AT HIGH TEMPERATURES. Sigurds Arajs and R. V. Colvin (U. S. Steel Corp. Research Center, Monroeville, Penna.). J. Less-Common Metals, 4: 159-68(Apr. 1961). (In English)

The specific heats at constant pressure of cerium, neodymium, and samarium in the paramagnetic state were analyzed in terms of lattice, electronic, and dilatation contributions. Electronic contribution is made up of two parts: specific heat due to the localized 4f-electrons and the usual electronic specific heat of conduction electrons. The experimental curves of temperature vs heat capacity at constant pressure can be fitted to the theoretical predictions reasonably well for cerium and only approximately for neodymium from 300 up to 800°K. This is not, however, possible for samarium. (auth)

16747 THE EFFECTS OF CARBON ON THE HARDNESS, MICROSTRUCTURE, AND COLD WORKING PROPERTIES OF HIGH-PURITY NIOBIUM. F. R. Cortes and A. L. Feild, Jr. (Universal-Cyclops Steel Corp., Bridgeville, Penna.). J. Less-Common Metals, 4: 169-80(Apr. 1962). (In English)

An investigation was conducted to determine the effects of carbon on the hardness, microstructure, and cold working properties of high purity niobium. Carbon additions of 0.012, 0.030, and 0.057% by weight were made to double electron beam melted niobium. Results showed that carbon is not an effective hardener of niobium up to the maximum level studied and that it is present primarily as a Nb_2C precipitate as a result of low solubility over a broad temperature range. Carbon in the form of a semi-continuous grain boundary carbide is harmful to cold working in concentrations as low as 0.03%. Vacuum annealing and quenching treatments demonstrated the dependence of cold working properties on the morphology of the carbides in a niobium matrix. (auth)

16748 THE ELECTRONIC STATE OF CERIUM IN THORIUM–CERIUM ALLOYS. D. S. Evans and G. V. Raynor (Univ. of Birmingham, Eng.). J. Less-Common Metals, 4: 181-90(Apr. 1962). (In English)

In spite of the fact that the atomic diameter of normal γ cerium exceeds that of thorium, the lattice spacing/composition curve for the thorium-cerium system contains a minimum at approximately 26 at.% cerium. Possible reasons for this behavior are discussed, and it is concluded that it is justifiable to regard the contraction of the cerium atom in thorium-rich alloys as due to the promotion of the single 4f electron to the conduction levels, brought about by a tendency to minimize the strain energy of solid solution. The process corresponds to abnormal contraction of γ cerium caused by the application of hydrostatic pressure.

An analogous effect to that observed in thorium-cerium alloys occurs in the thorium-plutonium system. Cerium is also contracted in cerium-rich thorium-cerium alloys. Analysis suggests that the magnitude of the contraction is related to the lattice contraction which would be expected from the solution of thorium in normal γ cerium. The contraction at any atomic percentage C of thorium between 0 and 50 may be represented by the expression KC (0.0759)/100 kX, where $K = 0.69 + 9 \cdot 10^{-4} C^{3/2}$. The mechanism of the contraction in this composition region is not fully understood, but may be related to the formation of an abnormally contracted form of cerium when normal γ cerium is cooled to low temperatures. The general implications of valency changes of the solute in solid solution are briefly discussed. (auth)

16749 A STUDY OF THE ELECTRICAL CONDUCTIVITY OF BERYLLIUM AND THE EFFECT OF PURITY. A. J. Martin, J. E. J. Bunce, and P. D. Tilbury (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Less-Common Metals, 4: 191-8(Apr. 1962). (In English)

Measurements were made of the electrical resistivity and temperature coefficient of resistivity of single- and poly-crystalline beryllium specimens. Both properties are shown to be particularly dependent on level of purity, and certain anomalies in the properties at elevated temperatures are ascribed to solution and precipitation effects. (auth)

16750 THE SOLUBILITY LIMITS OF ALUMINUM IN DELTA PLUTONIUM AND SOME REVISIONS OF THE PLUTONIUM–ALUMINUM PHASE DIAGRAM. F. H. Ellinger, C. C. Land, and W. N. Miner (Los Alamos Scientific Lab., N. Mex.). J. Nuclear Materials, 5: 165-72(Feb. 1962). (In English)

The δ-phase solvus and the $\delta/(\delta + \epsilon)$ boundary were determined by the x-ray lattice-spacing method. The maximum solubility of aluminum in δ plutonium was found to be 14.5 ± 0.2 at.% aluminum at the peritectoid temperature (788 ± 5°C). With decreasing temperature the solubility decreases to 13.6 at.% aluminum at 560°C where the solvus shows a point of inflection at its junction with the $\delta + PuAl \rightleftharpoons Pu_3Al$ peritectoid horizontal. Below 560°C the solubility decreases to 11.3 at.% aluminum at 350°C, the lowest temperature, so far, at which it is fairly certain that equilibrium was achieved. The precipitation behaviors of Pu_3Al and PuAl in δ phase are discussed. The intermediate phase PuAl was found to have decomposed into Pu_3Al and $PuAl_2$ after being aged at room temperature for 10 years. The equilibrium decomposition temperature was fixed at 193 ± 3°C. Changes in aged alloys containing the δ phase indicate that δ phase is stable at room temperature. Additional thermal-analysis work led to some modifications of liquidus and solidus temperatures. (auth)

16751 THE VARIATION OF TENSILE AND BEND PROPERTIES IN A BERYLLIUM SHEET. N. A. Hill (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 5: 193-9(Feb. 1962). (AERE-M-482). (In English)

Room temperature tensile and bend test results are reported for etched specimens taken from beryllium sheet. Three groups of approximately thirty specimens each, taken parallel, perpendicular, and at 45° to the rolling direction, were prepared and tested under identical conditions. There is a wide scatter of tensile results in all groups, the maximum scattering being approximately 33% of the mean value for the ultimate strength, and approximately 100% of the mean value for the elongation at fracture. The mean value for the 0.2% tensile proof stress does not vary with direction of testing but the scatter of results in all groups is about 50% of this value. The bend-test results show slightly less scatter than the tensile properties. The elongation at fracture in tension increases in an approximately linear relationship with the calculated true fracture stress and the maximum value of both occur where the texture most nearly approaches a basal plane layer texture. The elastic limit in bending is significantly higher than the 0.2% proof stress in tension, indicating that the elastic limit of beryllium is higher under complex stressing than under simple tension. (auth)

16752 DETERMINATION OF HYDRIDE SOLUBILITY IN ALPHA PHASE ZIRCONIUM, ZIRCALOY-2 AND ZIRCALOY-4. Gustaf Oestberg (Aktiebolaget Atomenergi, Stockholm). J. Nuclear Materials, 5: 208-15(Feb. 1962). (In English)

The solubility of hydrogen (hydride) in alpha phase Zircaloy-2 and Zircaloy-4 between 400 and 520°C was determined from Sieverts plots of experimental content and pressure values. A modified Sieverts apparatus was used, the performance of which was tested on pure zirconium. The solubilities obtained for Zircaloy-2 are somewhat lower than previously published values. Possible reasons for this difference are discussed with consideration of the methods of determination, the composition, and state of cold work of the alloys. Zircaloy-4 was found to have approximately the same hydrogen solubility as Zircaloy-2. (auth)

16753 OBSERVATIONS ON PHASE EQUILIBRIA AND SINTERING BEHAVIOUR IN THE PuO_2-UO_2 SYSTEM. L. E. Russell, N. H. Brett, J. D. L. Harrison, and J. Williams (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 5: 216-27 (Feb. 1962). (AERE-R-3519). (In English)

Phases present in UO_2 and PuO_2 mixed powder compacts of varying composition were determined after sintering in hydrogen and argon, after argon-arc melting, and after subsequent oxidation. Phase equilibria in the Pu–U–O system are discussed in terms of these findings. The sintering behavior of the mechanically mixed oxide powders was found to vary appreciably with composition and sintering atmosphere. (auth)

16754 A PRESSURE-COMPOSITION-TEMPERATURE STUDY OF THE ZIRCONIUM–HYDROGEN SYSTEM AT HIGH HYDROGEN CONTENTS. George G. Libowitz (Atomics International, Canoga Park, Calif.). J. Nuclear Materials, 5: 228-33(Feb. 1962). (In English)

In order to elucidate the phase diagram of the zirconium-hydrogen system at high hydrogen contents, a pressure-composition-temperature study in the temperature range 500 to 850°C was carried out. From the isotherms obtained, the position of the boundary between the two-phase ($\beta + \delta$) region and the single phase δ region was more precisely defined (β designates the hydrogen stabilized high temperature zirconium phase, and δ, the cubic hydride phase). The isotherms also showed the existence of a two-phase hydride region (cubic and tetragonal hydride co-existing) at elevated temperatures as has been observed at room temperature. (auth)

16755 THE ROLE OF FISSION GAS RE-SOLUTION DURING POST-IRRADIATION HEAT TREATMENT. G. W. Greenwood (Berkeley Nuclear Labs., Gloucester, Eng.) and A. Boltax. J. Nuclear Materials, 5: 234-40(Feb. 1962). (AERE-R-3572). (In English)

The process of heating irradiated uranium is analyzed in detail. The fission gas content in the lattice is such that it is supersaturated only with respect to the larger bubbles and re-solution of smaller bubbles may occur at a rate depending primarily on the solubility and diffusion rate of the gas. The analysis is applied to experimental results on post-irradiation heating of uranium in the γ-phase and a preliminary assessment is made of the heat of solution of the fission gases and the associated entropy factor. (auth)

16756 THE RELEASE OF Kr^{85} FROM IRRADIATED URANIUM DIOXIDE ON POST-IRRADIATION ANNEALING. E. Rothwell (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 5: 241-9 (Feb. 1962). (AERE-R-3672). (In English)

Release of Kr^{85} from irradiated uranium dioxide heated to temperatures above 1800°C is more rapid than predicted by simple extrapolation of data obtained at temperatures below 1500°C. The release was found to occur in three distinct stages, an initial burst on reaching the annealing temperature, a steady state release at constant temperature, and a release on cooling that starts at approximately 1450°C, irrespective of the cooling rate. This behavior was interpreted in terms of substoichiometry of uranium dioxide and segregation of gas bubbles to grain boundaries above 1800°C. (auth)

16757 A TERNARY COMPOUND IN THE U–Fe–C SYSTEM. P. Baldock (Atomic Energy Research Establishment, Harwell, Berks, Eng.), J. R. McLaren, H. J. Hedger, and G. Briggs. J. Nuclear Materials, 5: 257-8(Feb. 1962). (In English)

Metallographic evidence of a ternary compound was obtained during investigations on the U–C–Fe system. The compound is formed by peritectic reaction, with liquidus and solidus temperatures of 1740 ± 15 and 1615 ± 10°C, respectively. Chemical analysis, with minor corrections for the amount of free iron, obtained by a metallographic point counting technique gave a composition of 75.4 wt % U, 17.3 wt % Fe, 7.4 wt % C, corresponding very closely to an atomic ratio for U : Fe : C of 1 : 1 : 2. Powder data for UFeC$_2$ are tabulated. (P.C.H.)

16758 ON THE OCCURRENCE OF URANIUM METAL PARTICLES IN FUSED UO$_2$. R. Colombo and G. Frigerio (FIAT, Sezione Energia Nucleare, Turin). J. Nuclear Materials, 5: 259-61(Feb. 1962). (In English)

Microscopic examination, both optical and electronic, revealed the presence of inclusions of a light, soft phase at the grain boundaries and inside the UO$_2$ matrix. The shapes of the inclusions were surprisingly geometric in the UO$_2$ matrix. The O/U ratio measured by the oxidation to U$_3$O$_8$ method was 1.995 ± 0.004. Microhardness was measured on the UO$_2$ matrix and on the light phase inclusions, both within the matrix and at the grain boundaries. The hardness of the light phase is somewhat higher than that of the uranium metal, but the difference may be explained in terms of work-hardening during the mechanical polishing. Uranium metal segregates during solidification along the easy growth planes of the matrix and at the grain boundaries, owing to variations of the stable or metastable solubility of oxygen in UO$_2$. (P.C.H.)

16759 THE CRYSTAL HABIT OF URANIUM DIOXIDE. R. G. Robins, R. S. Wilks, and B. T. Bradbury (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 5: 262-3(Feb. 1962). (AERE-M-933). (In English)

The crystal habit of uranium dioxide single crystals was found to differ slightly, depending upon the method of preparation. The observed habits were $\{111\}\{100\}$, $\{111\}\{100\}\{331\}$, and $\{111\}\{100\}\{113\}$. Close relation between morphology and the detailed symmetry of atomic arrangement was demonstrated. (P.C.H.)

16760 PYROLYTIC GRAPHITES; HOW STRUCTURE AFFECTS PROPERTIES. R. J. Diefendorf (General Electric Co., Schenectady, N. Y.) and E. R. Stover. Metal Progr., 81: No. 5, 103-8(May 1962).

The effects of the layer-like crystal structure of pyrolytic graphite on its properties (e.g., oxidation rate, thermal conductivity, thermal expansion, and tensile-strength-to-density ratio) are reviewed. These properties are investigated both along and across the crystal layers. The effects of microstructure, plastic strain, and cracking under thermal stresses are also discussed. (T.F.H.)

16761 PREPARING VARIOUS GRAPHITES FOR METALLOGRAPHIC EXAMINATION. Theresa V. Brassard and Andrew S. Holik (General Electric Co., Schenectady, N. Y.). Metal Progr., 81: No. 5, 109-11(May 1962).

A method is described for polishing graphite samples, including samples of such materials as porous and friable powder compacts. The method uses rotating laps and fine abrasives of Al$_2$O$_3$, MgO, or diamond. Results are shown for pyrolytic graphite, alternately deposited graphite and soot layers, and a pressed compact of graphite powder. (T.F.H.)

16762 MAGNESIUM ALLOYS FOR NUCLEAR USE. Metal Progr., 81: No. 5, 190-3(May 1962).

The creep and cavitation resistance of Mg alloys such as Al–Be–Mg, Mg–Mn, and Mg–Mn–Zr are studied at 20 to 500°C. (T.F.H.)

16763 THERMAL EXPANSION MEASUREMENTS ON GRAPHITE–BROMINE COMPOUNDS. J. E. Brocklehurst (United Kingdom Atomic Energy Authority, Culcheth, Lancs, Eng.). Nature, 194: 247-9(Apr. 21, 1962).

The effect of residual bromine, formed in graphite by exposure to bromine vapor and subsequent desorption at room temperature, on the thermal expansion of graphite was investigated at 0 to 700°C. Measurements were made on two types of artificial extruded graphites, cut parallel and perpendicular to the extrusion axis, and on a pressed natural graphite compact cut parallel to the pressing direction. The results show a rapid increase in the thermal expansion coefficient above 300°C. (D.L.C.)

16764 INSTITUTE OF METALS SYMPOSIUM ON URANIUM AND GRAPHITE. Nuclear Eng., 7: 154-8(Apr. 1962).

The engineering aspects and fundamental considerations of using uranium and graphite as reactor fuel and moderator, respectively, are reviewed with respect to improving technology and gaining a clearer understanding of their behavior. The properties reviewed are phase changes, orientation, creep, swelling resistance, and dimensional changes. The effect of impurities and oxidation is also discussed. (N.W.R.)

16765 THE PROPERTIES OF G.E.C. IMPERMEABLE CARBON. H. W. Davidson (General Electric Co., Ltd. [Erith, Kent, Eng.]). Nuclear Eng., 7: 159-61(Apr. 1962).

Impermeable carbon is prepared by the direct carbonization of cellulose carbon. The carbon has a homogeneous structure, which is apparent from the glass-like appearance of the fracture surface. The density is less than that of commercial graphite. Optical micrographs confirm that the pore structure is not of the interconnected type. The pores have an average size of about 20 Å. The material has low permeability to gases and provides a complete barrier to the flow of fission gas from fissile fuel. The impermeable character is preserved at elevated temperatures. The material has a strength superior to that of normal graphites. The impermeable carbon exhibits a continual decrease in resistance as the test temperature is raised. Neutron radiation has practically no effect on the electrical resistance. Data are presented for each of the properties mentioned and compared with other materials. (N.W.R.)

16766 ZONE FORMATION IN ALUMINUM–ZINC ALLOYS. V. Gerold (Max-Planck-Institut für Metallforschung, Stuttgart). Phys. Status Solidi, 1: 37-49(1961). (In German)

It is shown by measuring the small angle scattering on an absolute scale, that the concentration of Zn atoms inside and outside of the spherical Guinier-Preston zones is a function of the aging temperature only and not of the initial concentration of the solid solution. This implies the existence of a metastable miscibility gap in the supersaturated solid solution. Using quantitative values of x-ray scattering from solutions containing 6 to 12 at. % Zn, the concentrations at the limits of the gap at room temperature were determined as $m_1 = 69.2$ at. % and $m_2 = 1.8$ at. %. Arguments are given which indicate that the miscibility gap develops in very short aging times. These results can be explained only by use of a zone model which involves two thermodynamically different phases. This is to be compared with the model postulated by Walker and Guinier which involves three different phases. (auth)

16767 CONTRIBUTION TO LOW CYCLE FATIGUE. Georg Sachs and Volker Weiss (Syracuse Univ., N. Y.). Z. Metallk., 53: 37-47(Jan. 1962). (In German)

Strain controlled low cycle fatigue studies were conducted on A-302 steel and the aluminum alloys 5454-O and 2024-T4. The experimental data are in good agreement with a relationship proposed by S. S. Manson, $N_F^{-1/2} \cdot \epsilon_{pt}$ = constant, which applies to completely reversed cycling. This relationship was expanded to apply to mean strains other than zero as well. In general the variables which affect the static fracture strain retain this effect for low number of cycles to failure. The effects of prestrain (cold work) and stress biaxiality fade out rapidly and become negligible above approximately 1000 cycles. The effect of the fracture strain, which itself can be regarded as a temperature dependent material constant, is retained to above 100,000 cycles. For low cycles to failure there appears to be no difference between tension-compression and reversed bend cycling. The effect of temperature cycling under constant load was studied on the aluminum alloys 7075-T6 and X2020-T6 and the magnesium alloys HK31A-H24 and AZ31B-H24. Under these conditions the deformation process is closely related to intermittent creep. The minimum plastic strain per temperature cycle is related to the number of cycles to failure according to $N_F \cdot \epsilon pc$ = constant. The effect of heating rate is inconsistent and seems to be indicative of a material instability such as stress and rate dependent aging. (auth)

16768 NITROGEN ALLOYS OF THE T METALS MANGANESE, IRON, COBALT, AND NICKEL WITH GALLIUM, GERMANIUM, INDIUM, AND ZINC. Hans H. Stadelmaier and Anna C. Fraker (North Carolina State Coll., Raleigh). Z. Metallk., 53: 48-51(Jan. 1962). (In German)

In the 16 systems investigated, ternary nitrides with the $L'1_2$ structure were found among the following five: cobalt–gallium–nitrogen, cobalt–germanium–nitrogen, cobalt–indium–nitrogen, cobalt–tin–nitrogen, and nickel–indium–nitrogen. A ternary nitride with a tetragonal structure was observed in the system iron–germanium–nitrogen. In addition, the B-metals gallium, germanium, indium, and tin extend considerably the homogeneity range of the binary γ' iron nitride. (auth)

16769 THE MAGNETIC PROPERTIES OF THE β-MODIFICATION OF URANIUM HYDRIDE AND DEUTERIDE. A. I. Karchevskii and E. M. Buryak. Zhur Ekspt'. i Teoret. Fiz., 42: 375-82(Feb. 1962). (In Russian)

The magnetization and paramagnetic susceptibility and also the magnetocaloric effect in the β modifications of UH_3 and UD_3 are investigated. The molar magnetizations of these compounds at liquid helium temperatures only slightly differ; it is about 6% higher in UH_3 than in UD_3 and this contradicts the results of Henry. The Curie point was determined on basis of the temperature dependence of the spontaneous magnetization (181°K for UD_3 and 177.5°K for UH_3) and from the peak of the magnetocaloric effect (182.0°K for UH_3 and 178.4°K for UD_3). The magnetocaloric effect at the Curie temperature in UH_3 exceeds the corresponding value in the deuteride by 1.4 ± 0.15 times. It is shown that no contradiction exists between the calorimetric measurements and the results of the magnetic investigations. (auth)

16770 THE EVALUATION OF CREEP TESTS ON ALPHA-URANIUM UNDER ISOTHERMAL AND THERMAL-CYCLING CONDITIONS. L. R. T. Gardner and W. N. Miller (United Kingdom Atomic Energy Authority, Springfields, Lancs, Eng.). p.28-8 of "Institute of Metals Symposium on Uranium and Graphite, 1962." Paper No. 4. [London], The Institute of Metals, 1962.

Creep data obtained for uranium are reviewed, and isothermal secondary creep rates ($\dot{\epsilon}$) are fitted to a law of the type $\dot{\epsilon} = \sigma^n \exp(A + B/T)$, where σ is the applied stress (lb/in^2) and T is the absolute temperature (°K). The best fit for the acceptable data is given by $A = -0.824$, $B = -23{,}400$, and $n = 2.61$. The effect of continuous thermal cycling on the isothermal creep rate is evaluated, and a procedure is given that predicts numerically the creep behavior of a specimen undergoing continuous thermal cycles greater than a few degrees. (auth)

16771 BERILLIĬ. KHIMICHESKAYA TEKHNOLOGIYA I METALLURGIYA. (Beryllium. Chemical Technology and Metallurgy). G. F. Silina, Yu. I. Zarembo, and L. E. Bertina—V. I. Spitzyn, ed. Moscow, Atomizdat, 1960. 120p.

Descriptions are given of the physico-chemical, nuclear, mechanical, and corrosion properties of beryllium and of technological methods of producing pure beryllium and beryllium compounds. (R.V.J.)

16772 IMPROVEMENTS RELATING TO ZIRCONIUM ALLOYS. Geoffrey Charles Edward Olds (to Associated Electrical Industries Ltd.). British Patent 894,156. Apr. 18, 1962.

A Zr alloy having good creep properties above and below 500°C comprises 0.25 to 3% Cu, 3 to 7% Nb, 0.25 to 3% Mo, and balance Zr. (D.L.C.)

Radiation Effects

Refer also to abstract 16056.

16773 (AE-65) IRRADIATION EFFECTS IN STRAIN AGED PRESSURE VESSEL STEEL. M. Grounes and H. P. Myers (Aktiebolaget Atomenergi, Stockholm). Feb. 1962. 7p.

Tensile specimens, Charpy-V notch and subsize impact specimens of an Al killed carbon manganese steel, were irradiated at 160 to 190°C in the reactor G1. The total neutron dose received was 2.4×10^{18} n/cm^2 (>1 Mev). Specimens were prepared from normalized plate and from strain aged material from the same plate. It was found that the changes in brittle ductile transition temperature due to neutron irradiation and those due to strain ageing must be considered additive. (auth)

16774 (ARL-132) RADIATION INDUCED OVERAGING OF A 2024-T3 ALUMINUM ALLOY. Attwell M. Adair, Rollin E. Hook, and Harold J. Garrett (Wright Air Development Center. Aeronautical Research Lab., Wright-Patterson AFB, Ohio). Sept. 1961. 12p.

Annealing experiments on both irradiated and unirradiated samples of a 2024-T3 aluminum alloy were followed by metallographic examination, hardness measurements, and an analysis of x-ray back reflection patterns. The severely overaged condition after neutron irradiation previously reported by Wallack is shown to be primarily radioinduced and not due only to a high ambient temperature. This overaging is attributed to an excess vacancy concentration during irradiation equivalent to at least an additional 150°C in sample temperature. (auth)

16775 (CRFD-1044) IRRADIATION OF UO_2 SPECIMENS WITH MOLTEN CORES IN A PRESSURIZED WATER LOOP. Test X-2-x. A. S. Bain (Atomic Energy of Canada Ltd., Chalk River, Ont.). Aug. 1961. 26p. (Exp-NRX-6203; AECL-1464).

Two Zircaloy-2 clad specimens containing stoichiometric UO_2 pellets were irradiated in a pressurized water loop for 379 hours at heat ratings sufficient to cause central melting of the UO_2. There was no appearance of localized overheating or accelerated corrosion of the sheath, but the diametral increases were considerably larger than those observed in loop specimens irradiated at lower heat ratings. The length increases, however, were approximately the same as those measured for specimens at lower ratings. There was a clearly visible demarcation between UO_2 that had been molten and that which had not. The value of $\int_{500°C}^{T_m} k d\theta = 74 \pm 3$ W/cm was essentially the same as that obtained from the short-duration tests in the hydraulic rabbit, indicating there is no marked decrease in thermal conductivity of the UO_2 fuel in irradiations up to 379 hours. (auth)

16776 (CRFD-1067) THE IRRADIATION OF DEFECTED ZIRCALOY-2 CLAD UO_2 FUEL ELEMENTS CONTAINING FLUORIDE IMPURITIES (IRRADIATION TEST X-204). M. J. F. Notley, R. D. MacDonald, G. W. Parry, and G. M. Allison (Atomic Energy of Canada Ltd., Chalk River, Ont.). Jan. 1962. 39p. (AECL-1473)

Tests confirmed the hypothesis that rapid catastrophic failures of Zircaloy-sheathed defected UO_2 fuel elements can be caused by the presence of approximately 500 ppm fluoride in the UO_2. The previous, satisfactory behavior of defected fuel elements is typical of the more normal production material. It is therefore suggested that the failures encountered were due to the high fluoride content of the UO_2 used in the tests. The fabrication, irradiation testing, and post-irradiation examination of the elements in this experiment are described. (auth)

16777 (DC-58-4-71) ACCOMPLISHMENT REPORT ON THE HIGH TEMPERATURE RADIATION TOLERANT COMPONENT PROGRAM. Milestone III, Task 1270. William N. Davidson (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Apr. 8, 1958. Contract AT(11-1)-171. 89p.

The development, procurement, and testing of electronic components is described. Development programs were for high-temperature, radiation-tolerant tubes, capacitors, and semiconductor diodes. (auth)

16778 (JPL-TR-32-234) EFFECTS OF IONIZING RADIATION ON SOLID ROCKET MOTOR COMPONENTS. Richard E. Gardner (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Dec. 21, 1961. Contract NAS 7-100. 19p.

Problems which the solid propellant rocket engineer will encounter in designing for long-term storage in a radiation environment are discussed. A summary of present knowledge of the radiation environment is given. Mechanisms of radiation degradation and its effects on tensile properties of propellant binders are discussed qualitatively. Data from a program of irradiation of several propellants are presented. Properties of two of the propellants were changed significantly by doses of the order of 4×10^6 rads. (auth)

16779 (NARF-62-2T) STRESS-STRAIN BEHAVIOR OF IRRADIATED POLYURETHANE ELASTOMERS. P. M. Johnson and E. G. Fritz (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Feb. 23, 1962. Contract AF33(657)-7201. 29p. (MR-N-293)

The applicability of the Martin-Roth-Stiehler stress-strain relationship to a number of reactor-irradiated (gamma-ray dose range: 0 to 1.9×10^{10} ergs/gram in carbon) polyurethane elastomers is demonstrated. For each level of dose and irradiation temperature, the stress-strain values showed remarkably good agreement with the behavior predicted by this relationship, thus permitting a realistic characterization of the stress-strain curves up to extension ratios of 3 by two parameters: the tangent modulus E_0 and a coefficient K. While the available data did not justify conclusive inferences regarding the explicit nature of the functions $E_0(D)$ and K(D), it appears from this analysis that E_0 varies exponentially with dose D and that K is a slowly varying function of dose. (auth)

16780 (NARF-62-3T) EFFECTS OF REACTOR RADIATION ON THE PROPERTIES OF MIX BIS (PHENOXYPHENYL) ETHER OPERATING IN A HYDRAULIC PUMP LOOP. E. C. Shellhase, R. H. McDaniel, and F. A. Haley (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Mar. 30, 1962. Contract AF33 (657)-7201. 43p. (MR-N-292)

An experimental hydraulic fluid, mix bis (phenoxyphenyl) ether, was irradiated under operational environmental conditions imposed by a hydraulic pump loop. The Ground Test Reactor was used to provide a mixed neutron-gamma radiation field. The fluid was exposed to an average dose of 2.7×10^{10} ergs/gm(C) of gamma radiation and 3.9×10^{18} nvt of neutrons ($E_n > 2.9$ Mev). Pump-loop conditions during irradiation were 3000 psi and 4-gpm flow. Bulk-oil temperature ranged from 326 to 340°F. A preirradiation control evaluation was conducted with the pump loop operating 9.75 hours and bulk-oil temperature ranging from 350 to 380°F. The results of property and performance tests conducted on samples of the fluid during irradiation were compared to data on the nonirradiated fluid to assess the radiation damage. (auth)

16781 (WADD-TN-60-251) ANALYSIS AND DESIGN OF AN ELECTRON GUN-MOLECULAR BEAM INSTRUMENT FOR USE IN FREE RADICAL STUDIES. [Period Covered] December 1959 through August 1960. Michael P. Charles (Wright Air Development Div. Materials Central, Wright-Patterson AFB, Ohio). Feb. 17, 1961. 52p. (AD-266725)

An instrument was developed and built for use in studying primary and intermediate effects of radiation upon different materials. This instrument is an electron gun-molecular beam device. Its function is to form a molecular beam with a long mean free path length from a known gas. The molecular beam is then irradiated by the electron gun, producing excited states, ions, and free radicals. Due to the length of time from irradiation to being collected on a 4.2°K cold finger the excited states and ions return to their normal state, leaving only the free radicals for study. The free radicals are then studied at different temperatures from 4.2°K to room temperature with the use of infrared and electron paramagnetic resonance techniques. It is believed that this method will produce an accurate, reliable history of radiation effect processes which a material will undergo after initial irradiation. (auth)

16782 ESTABLISHMENT OF AN ORDERED Fe-Ni STRUCTURE BY NEUTRON IRRADIATION. Jean Pauleve, Daniel Dautreppe, Jean Laugier, and Louis Neel (Centre d'Études Nucléaires, Grenoble, France). Compt. rend., 254: 965-8(Feb. 5, 1962). (In French)

Neutron irradiation, in magnetic fields, of a 50% Fe–Ni alloy gives birth to a very strong magnetic anisotropy caused by the formation of an FeNi structure of the AuCu type. The critical temperature of the corresponding order-disorder transformation is close to 330°C. The ordering is sensitive to the direction of the magnetic field. (tr-auth)

16783 COLD WORKING RECOVERY OF FAULTS CREATED IN IRON BY IRRADIATION. René Conte, Bernard Dreyfus, and Louis Weil (Université, Grenoble, France and Centre d'Études Nucléaires, Grenoble, France). Compt. rend., 254: 1023-5(Feb. 5, 1962). (In French)

Repeated torsions at room temperature produce, from the point of view of the apparent modulus, hardening, and internal friction, a partial recovery of faults created in a monocrystalline fiber of iron by neutron irradiation. (tr-auth)

16784 THE SYSTEMATIC ANALYSIS OF ZIRCONIUM AFTER NEUTRON IRRADIATION. Louis Fournet and Philippe Albert (Centre National de la Recherche Scientifique, [Paris]). Compt. rend., 254: 1076-8(Feb. 5, 1962). (In French)

The systematic analysis of aluminum and iron after irradiation by neutrons was described previously (Compt. rend., 254: 682(1962)). The application of these analytical methods to zirconium is reported. (tr-auth)

16785 THE METHOD OF IRRADIATION OF SOLID DIELECTRICS IN NUCLEAR REACTORS. L. K. Vodop'yanov and V. V. Krasnopevtsev (Lebedev Inst. of Physics, Moscow). Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: No. 11, 129-31(Nov. 1961). (In Russian)

16786 KOSSEL LINE STUDIES OF IRRADIATED NICKEL CRYSTALS. R. E. Hanneman (Massachusetts Inst. of Tech., Cambridge), R. E. Ogilvie, and A. Modrzejewski. J. Appl. Phys., 33: 1429-35(Apr. 1962).

Irradiation damage of nickel single crystals bombarded with 3-Mev electrons was studied by Kossel line techniques. Changes of lattice parameter and x-ray line breadth were determined for crystals bombarded with integrated dosages of 10^{16}, 10^{17}, and 10^{18} electrons/cm^2 at liquid nitrogen temperature. Formation of Frenkel defects in the lattice due to the electron bombardment is consistent with the data obtained. Subsequent annealing studies support this conclusion. Using an electron microbeam probe to obtain the Kossel patterns, the absolute precision of the lattice parameter obtained is better than 1 part per 100,000 or ±0.00003 A. The limit of relative precision of change in lattice parameter of a given crystal is 3 parts per 1,000,000 or 0.00001 A. Basic principles of the formation of Kossel lines, experimental arrangements, various errors, and related models are presented. (auth)

16787 OBSERVATION OF FISSION FRAGMENT DAMAGE IN THIN FILMS OF METALS. J. J. Kelsch, O. F. Kammerer, A. N. Goland, and P. A. Buhl (Brookhaven National Lab., Upton, N. Y.). J. Appl. Phys., 33: 1475-82 (Apr. 1962).

Direct observation of the effects of fission events was made in thin films of Al and Pt by transmission electron microscopy. A very thin layer (10 to 20 A thick) of UO_2 was incorporated between evaporated metal films. The samples were exposed to a total thermal neutron flux of 2.8×10^{15} n/cm^2. The fission fragments produced tracks in the matrix, the characteristic appearance of which is strongly influenced by the thickness and the atomic number of the matrix. The mechanism of track formation is discussed from the viewpoint of dissipation of energy by the thermal spike mechanism. (auth)

16788 IRRADIATION GROWTH IN ALPHA-URANIUM SINGLE CRYSTALS. Peter R. Morris (National Lead Co. of Ohio, Cincinnati). J. Appl. Phys., 33: 1611-12(Apr. 1962).

Neglecting local damage to the lattice in alpha-uranium single crystals irradiated by thermal neutrons, the unit cell may be regarded as invariant during the process; the crystallographic directions remain unchanged. The ratio of length in an arbitrary crystallographic direction following irradiation to that preceding irradiation is a function of crystal shape. The case of a crystal initially spherical in shape is considered, and relations are given. (L.N.N.)

16789 LOW-TEMPERATURE RESISTIVITY OF SODIUM AND THE EFFECTS OF NUCLEAR IRRADIATION. T. H. Blewitt, R. R. Coltman, C. E. Klabunde, and L. McDonald (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 33: 1612-13(Apr. 1962).

Neutron irradiation effects on sodium electrical conductivity at low temperatures were measured using the hole 12 cryostat of the Oak Ridge graphite reactor. Data were compared with those for copper; it is suggested that the displacement threshold for sodium is less than that for copper. Results from pulse-annealing studies are presented in graphical form. The importance of the thermal history of sodium is stressed; sodium is far from an ideal simple metal. (L.N.N.)

16790 DISLOCATION BEHAVIOR IN QUENCHED AND IN NEUTRON IRRADIATED STAINLESS STEEL. H. G. F. Wilsdorf (Franklin Inst., Philadelphia) and D. Kuhlmann-Wilsdorf. J. Nuclear Materials, 5: 178-92(Feb. 1962). (In English)

Dislocation behavior in unirradiated as well as neutron irradiated stainless steel was investigated by the thin-film technique in the electron microscope. Irradiation of stainless steel does not cause defects which give rise to discernible diffraction effects. Instead radiation damage seems to consist simply of a strong supersaturation of point defects, possibly in the form of some type of three-dimensional aggregate, without associated stress field. The supersaturated point defects, which also are present to some extent in the non-irradiated material, cause old dislocations to be firmly anchored, lead to some climb during glide in new dislocations in thin foils, and, by inference, cause the mechanism of mushrooming in bulk material. Some additional observations on network formation and on dislocation trails are related, and tentative explanations given. (auth)

16791 NON-DESTRUCTIVE TECHNIQUES FOR ASSESSING RADIATION DAMAGE IN PRESSURE VESSEL STRUCTURAL MATERIALS. Friedrich Foerster. News Non-Destructive Material Testing, Solus-Schall, No. 20, 9-26(Apr. 1961). (In English)

Nondestructive techniques which show that neutron radiation raises the transition temperature from brittle to ductile behavior are described and discussed. The techniques are illustrated by measuring the mechanical properties of pressure vessel structural materials such as copper, carbon steel, and other steel materials. The equipment for measuring the mechanical properties and radiation damage is described. The effects interfering with the measurements are discussed along with the interpretation of the results. The optimum dimensions of the sample to be tested by the various methods are also discussed. (N.W.R.)

16792 EFFECTS OF HIGH ENERGY IRRADIATION ON PHOSPHORS. N. Riehl and R. Sizmann (Technische Hochschule, Munich). Phys. Status Solidi, 1: 97-119(1961). (In German)

A review is given of studies made on the effects of high energy radiation on phosphors. The general theoretical bases of the interaction between high energy particles and the lattice constituents are first summarized. The theory is developed for the lattice which is built up of identical atoms as in the case of pure metals. This theory is then expanded to the lattice composed of two types of atoms (AB compounds). This expansion is applicable to phosphors of the AB type as ZnS and CdS. The experimental results obtained in a study of the radiation effects on crystals of the AB type are summarized in conclusion. (J.S.R.)

16793 THE EFFECT OF X IRRADIATION ON THE SPECTRAL DISTRIBUTION OF THE PHOTO YIELD OF CdS SINGLE CRYSTALS. E. H. Weber and B. Wojtowicz (Physikalisch-Technisches Institut der Deutsche Akademie der Wissenschaften, Berlin and Humboldt-Universität, Berlin). Phys. Status Solidi, 1: K7-K11(1961). (In German)

In a study of the effects of x radiation on the photo yield of CdS single crystals, the spectral distribution of the photocurrent was recorded for cleavage cells provided with vapor-deposited indium contacts. In order to reduce the perturbation of the spectral distribution by the gas atmosphere, the measurements were carried out in high vacuum. The photocurrent was measured just before irradiation, immediately after irradiation, and just after a second and then a third irradiation. The results showed that the maximum at about 515 $m\mu$ is composed of at least two maxima; a short wave maximum which decays rapidly under x radiation and a long-wave maximum which slowly increases under x radiation. The decay of the long-wave maximum occurs relatively rapid. The recovery of the short-wave maximum takes place over a longer period (several hours or days). (J.S.R.)

16794 LOW TEMPERATURE ANNEALING STAGES OF IRRADIATED COPPER. Ryukiti R. Hasiguti (Tokyo Univ.). Proc. Japan Acad., 36: 335-9(1960). (In English)

A mechanism, the principal feature of which is the trapping of interstitial atoms by impurity atoms, is proposed to explain the annealing stages of Cu from about 14 to 473°K. (T.F.H.)

16795 SOME EXPERIMENTAL TECHNIQUES OF LOW-TEMPERATURE RADIATION DAMAGE STUDIES. R. L. Chaplin and P. E. Shearin (Univ. of North Carolina, Chapel Hill). Rev. Sci. Instr., 33: 459-62(Apr. 1962).

Radiation damage studies of metal specimens were achieved by using a Van de Graaff accelerator to supply energetic electrons. The irradiating electrons are magnetically deflected so that the electron beam bombards a well-defined rectangular area. A method is described which is used to determine the location of the beam with respect to the position of the specimen. A low temperature thermal switch is discussed in terms of its theoretical and experimental behavior. A practical method for improving the thermal contact between the specimen and its holder by using the helium exchange gas technique is described. Estimates of the degree of thermal contact between specimen and specimen holder are possible because of the particular electrical circuit in the experimental chamber. (auth)

16796 THE EFFECT OF NEUTRON IRRADIATION AND THERMAL CYCLING ON PERMANENT DEFORMATIONS IN URANIUM UNDER LOAD. R. G. Anderson and J. F. W. Bishop (United Kingdom Atomic Energy Authority, Springfields, Lancs, Eng.). p.17-23 of "Institute of Metals Symposium on Uranium and Graphite, 1962." Paper No. 3. [London], The Institute of Metals, 1962.

The Cottrell "creep" effect in polycrystalline uranium irradiated in a neutron flux at low temperatures is explained, using a model in which each grain continues to deform anisotropically while stressed to a yield point by the mutual restraints of the aggregate. An estimate of the analogous (time-independent) deformation occurring during a large thermal cycle is given. The model is developed to cover the case in which the internal stresses do not cause yielding, but are sufficient to lead to an accelerated creep mechanism under small applied stresses. The cases of creep accelerated by irradiation growth at temperatures in the range 350 to 450°C and by small thermal cycles in the temperature range above 500°C are worked out. Results indicate that an error of two orders of magnitude can be made by neglecting such effects and relying on isothermal creep data. The integrated effect of internal stresses during relaxation in producing a component of primary creep is analyzed, and shown to give a permanent deformation of several elastic deflections occurring over a period subsequent to a large thermal cycle. Such deformations are additive to the time-independent deformation occurring during the large thermal cycle. (auth)

16797 RADIATION-RESISTANT LUBRICANTS. Stanley Francis Birch and Roy Turner (to British Petroleum Co.). British Patent 894,009. Apr. 18, 1962.

A method is given for preparing radiation-resistant lubricants which are liquid at room temperature. The method comprises alkylating benzene with propylene tetramer at 50 to 100°F in the presence of HF as catalyst, recovering from the alkylate a distillate fraction boiling above 250°C, preferably in the 340 to 460°C range, and adding 5 wt % of a viscosity index improver, such as polyisobutylene or polymethacrylate. The lubricant may also be thickened with a grease thickening agent. (D.L.C.)

16798 IMPROVEMENTS IN OR RELATING TO THE OPERATION OF MACHINERY EXPOSED TO ATOMIC RADIATION. (to Socony Mobil Oil Co., Inc.). British Patent 894,204. Apr. 18, 1962.

A lubricating oil which is resistant to radioinduced increases in viscosity comprises a mineral lubricating oil containing a minor proportion of an oil-soluble benzene ring-containing polymer. The polymer preferably is a hydrocarbon polymer of molecular weight 50,000 to 100,000, especially an alkylated polystyrene containing 1 to 3 alkyl radicals per styrene unit, and the preferred proportion of the polymer to the oil is 0.5 to 1 wt %. (D.L.C.)

PHYSICS

General and Miscellaneous

Refer also to abstracts 16058, 16095, 16516, and 16638.

16799 (AD-265462) HIGH-TEMPERATURE BROADBAND SEMICONDUCTORS. Quarterly Technical Summary Report for the Period January 1, 1961 through March 31, 1961. S. W. Kurnick, M. F. Merriam, G. L. Guthrie, and J. Appel (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Apr. 10, 1961. Contract NObs-77144. 58p. (GACD-2165)

Fundamental work on Ce–S was continued in the attempt to achieve better understanding of the electrical and thermal transport mechanisms of compounds having the Th_3P_4 structure. Work was begun on the synthesis and evaluation of related compounds which show promise as high-temperature thermoelectric materials. These are the Th_3P_4-structure rare-earth sulfides of La, Pr, and Gd. Theoretical interpretation included analysis of the Seebeck coefficient in polar semiconductors. Emphasis was placed on polaron theory, a transport mechanism which shows promise in application for the selection of better thermoelectric materials. (auth)

16800 (AD-266440) ENERGY CONVERSION INCLUDING MAGNETOAERODYNAMIC STUDIES AND THERMIONIC CONVERTERS. THERMIONIC CONVERTER STUDIES. Semiannual Technical Report, January 1–June 30, 1961. R. C. Horn (Aerospace Corp., El Segundo, Calif.). Contract AF04(647)-594. 22p. (TDR-594(1201-03)TR1(Pt.II))

A plane-parallel cesium thermionic converter was constructed. A second converter, which permits spectrographic determination of cesium species temperatures and densities, was designed. Analytical studies of plasma and sheath phenomena occurring in high pressure operation of a converter are in progress. Elastic scattering cross sections and momentum transfer cross sections for collisions of low energy were previously calculated. A literature survey of transition probabilities for transitions from the ground state in cesium was conducted and a tabulation of experimental values made. (auth)

16801 (AFCRL-62-239) VERY LOW PRESSURE GAS BREAKDOWN USING SECONDARY ELECTRONS. Scientific Report No. 1. M. A. Levine (Air Force Cambridge Research Labs., Bedford, Mass.), and A. G. Rubin (Williamson Development Co., Inc., West Concord, Mass.). Aug. 1961. Contract AF 19(604)-4091. 23p.

Breakdown was produced in hydrogen and helium at pressures down to 10^{-6} mm Hg in a toroidal chamber placed in a uniform r-f field and in a betatron focusing field. An explanation of the breakdown characteristics is attempted which relies on secondary electron emission from the walls to produce the initial rapid rise in electron density. An electrostatic wall field and an effective radial potential well due to the r-f field are invoked to explain long containment times (auth)

16802 (AFOSR-1934) THERMODYNAMIC PROPERTIES OF FINITE CHAINS OF EXCHANGE-COUPLED ATOMS. Technical Note No. 131-17. R. B. Griffiths (Stanford Univ., Calif.). Dec. 1961. Contract AF18(603)-131. 43p.

The energy, entropy, specific heat, and susceptibility, all in the limit of zero external magnetic field, were computed for finite chains (actually closed "rings") of spin $^1/_2$ atoms coupled by an isotropic exchange interaction between nearest neighbors. The calculations were carried out for chains containing 2, 3, 4, ... , 10 atoms, and for both ferro- and antiferromagnetic coupling. The convergence as the number of atoms in the chain, N, increases suggests that the thermodynamic quantities obtained for a 9 or 10 spin chain provide a fairly good approximation to the same quantities in the limiting case of an infinite chain, at temperatures above $|J|/k$ (J is the exchange integral), and in some cases even for slightly lower temperatures. In addition it is found that at any fixed temperature the energy, Helmholtz free energy, and susceptibility as a function of N are monotone increasing (ferromagnetic case) or monotone increasing for N even and monotone decreasing for N odd (antiferromagnetic case). A similar monotone behavior is found for the antiferromagnetic entropy and specific heat (the latter only for N odd). Numerical values for energy, entropy, specific heat, and susceptibility are given for $N = 9, 10$. Finite chains with Ising interaction are briefly discussed, and the thermodynamic quantities are shown to exhibit several of the monotonicity properties found for the isotropic interaction. (auth)

16803 (AFOSR-2194) CURRENT DISTRIBUTION AND FLOW MODEL FOR LARGE RADIUS-RATIO MAST. Research Report No. 117. J. C. Keck, F. Fishman, and H. Petschek (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). Jan. 1962. Contract AF49(638)-659. 12p.

In the magnetic annular shock tube (MAST), the driving force is an azimuthal magnetic field produced by a radial current between the concentric cylinders defining the annulus. Since this magnetic field varies inversely as the distance from the axis of the device, there is a variation in the driving pressure across the annulus, which leads to non-uniformities in the flow. An analysis is presented which is concerned with the nature of the non-uniform flow in a MAST with an annular spacing larger than the radius of the inner cylinder. Experiments were conducted in a MAST with inner and outer radii of 1 and 3 inches. The speed of the disturbance produced in the tube was found to depend upon the polarity of the discharge, being 5.3 cm/μsec with the center electrode positive and 4.7 cm/μsec with the inverse polarity. The distribution of current in the tube was determined with probe coils; it too, depended on polarity. With the inner electrode positive the current was largely confined to a thin sheet that was strongly canted with respect to the walls, the inner edge leading. A thicker current sheet that was nearly normal to the tube walls was observed in the inverse polarity condition. A model is proposed to explain the operation with positive center electrode. The shape of the forward part of the current sheet is calculated by balancing the magnetic pressure behind the sheet with the gas pressure in front; the Newtonian approximation is used for the gas pressure. The resulting shape, which is approximately parabolic, agrees roughly with experiment. It is proposed that the dependence of the flow on polarity is associated with electron emission problems, and that in positive operation the ions carry a substantial part of the current. (auth)

16804 (AFOSR-2300) LATTICE VIBRATIONS OF ZINCBLENDE STRUCTURE CRYSTALS WITH APPLICA-

TION TO ZnS. Harvey Kaplan and John J. Sullivan (Syracuse Univ., N. Y.). [1960?]. 32p.

The vibrations of the zincblende lattice were studied using the shell model of Dick and Overhauser and of Cochran. Only nearest neighbor short range force constants of core-core, core-shell, and shell-shell types were included in the model in addition to the coulomb forces between the charged shells and cores. The model is applied to ZnS for which only long wavelength experimental data is available. It is established that the effective ionic charge of the Zn ion in ZnS (the sum of the core and shell charges of the ion) is probably near +0.1 electronic charges. After the long wavelength data were included in the model, enough freedom remains to fit a wide variety of short wavelength data. The short wavelength transverse frequencies in the (100) direction in the Brillouin zone are particularly sensitive to the ratio of electronic polarizabilities of the two ions, tending to be depressed when the polarizabilities are made more nearly equal. The calculation is compared with other calculations of the vibration spectrum of ZnS. (auth)

16805 (ARF-3182-5) THERMOCHEMICAL AND THERMODYNAMIC DATA ON SELECTED COMPOUNDS FOR THE CHEMICAL CONVERSION OF WASTE HEAT TO ELECTRICAL ENERGY. Phase Report. Richard H. Snow (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Aug. 16, 1961. Contract NOw-60-0760-c. 142p. (AD-265376L)

Thermochemical data for 58 families of compounds are newly compiled. Included are halides and a few oxide families of metals which can exist in more than one valence state. Heats of formation, heats of transition, transition temperatures, coefficients of heat capacity equations, and coefficients of integrated heat of formation and free energy of formation equations are tabulated. Computer-produced graphs give free energy of formation at 298 to 1500°K or higher. The main contribution of this work is a revision of estimates by Brewer and Glassner of thermodynamic properties for which experimental data are not available. Such revisions are based on new experimental values of related properties. Also included are calculated temperatures at which run-down products of galvanic cells can be thermally regenerated. (auth)

16806 (BSD-TDR-62-42) EXACT SOLUTIONS TO A CLASS OF LINEARIZED MAGNETOHYDRODYNAMIC FLOW PROBLEMS. Research Report No. 124. R. H. Levy (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). Nov. 1961. Contract AF04(694)-33. 25p.

A general discussion of the properties of magnetohydrodynamic flows at low conductivity is given, and then attention is restricted to the class of such flows satisfying the following conditions: the flow is steady, two-dimensional, inviscid, and only slightly perturbed from uniform conditions; the magnetic field vector is also two-dimensional and lies in the plane of the flow; the distortion of the applied field by the induced currents is negligible; physical boundaries on the flow are one or two infinite plates parallel to the flow direction; and the conductivity of the field is a scalar quantity, but may vary in a restricted manner with position. With these assumptions, the perturbations to the flow were calculated exactly for arbitrary magnetic fields for the cases in which the undisturbed flow is either incompressible or supersonic. Illustrative examples for simple magnetic fields were evaluated; for some of these examples the subsonic case was also treated. Another particular example was used to show the effect of spatially varying conductivity on the flow. The limits of the applicability of these results are discussed, and general conclusions regarding the nature of the flow perturbation are drawn. (auth)

16807 (GA-3093) CARBIDE CATHODE STUDIES PHYSICAL AND CHEMICAL REDEPOSITION. Quarterly Progress Report, January 22, 1962–March 31, 1962. S. Langer and L. Yang (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Apr. 18, 1962. Contract NAS 3-2301. 17p.

Activities are reported in a program to investigate the physical and chemical means by which the vaporization loss from carbide cathodes at their operating temperatures (2100 to 2500°K) may be reduced or eliminated. Included are physical redeposition studies concerning the effect of anode temperature and the nature of anode materials on the vaporization and condensation of carbide cathodes, and chemical redeposition studies of carbide additions of H and halogens into the thermionic cell. During this period, the nucleation and growth theories were employed to examine the effect of anode temperature and the nature of anode materials on the mass transport between the cathode and the anode. It is shown that the lack of information on the vapor-solid and solid-solid interfacial energies and on other physical properties of the surfaces hampers the selection of proper anode temperature and anode material for such purposes on purely theoretical approaches, and that experimental studies are needed. Apparatus for the study of the chemical transport between a UC cathode and a Pt anode in the presence of halogens is being assembled. Thermodynamic calculations of the species present in Cs halide vapors and halogens were carried out. (auth)

16808 (NP-11472) DIREKTE WANDLUNG VON THERMISCHER ENERGIE IN ELEKTRIZITÄT DURCH THERMIONISCHE UND MAGNETOHYDRODYNAMISCHE GENERATOREN. LITERATURÜBERSICHT MIT ANNOTATIONEN. JAHRESBERICHT 1961. (Direct Conversion of Thermal Energy to Electricity by Means of Thermionic and Magnetohydrodynamic Generators. Literature Review with Abstracts. Annual Report, 1961). Oskar Liskowsky, comp. (Kernforschungsanlage, Jülich, Germany). Feb. 1962. 35p. (Bibl./Dok./1962/1).

A literature review on direct conversion of thermal energy to electricity by thermionic and magnetohydrodynamic cells is presented. The 98 references gathered in 1961 are given together with abstracts without regard to origin, language, or form under the following headings: general and comprehensive literature, thermionic conversion, and magnetohydrodynamic conversion. The sources of the references are Nuclear Science Abstracts, Physics Abstracts, and Electrical Engineering Abstracts. Subject, author, corporate, report number, and periodical indexes are included. (M.C.G.)

16809 (PG-Report-314) ANALYTICAL METHOD FOR THE MEASUREMENT OF NEUTRON EMISSION FROM PLUTONIUM BILLETS (BORON TRIFLUORIDE COUNTERS). (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1962. 4p.

The plutonium billet, in its aluminum casket and polythene liner, is lowered into a paraffin wax moderating castle, in which boron trifluoride neutron detectors are housed. The pulses produced are amplified and recorded. After correcting for background, the total neutron emission of the billet is calculated by reference to a standard source, housed in a similar aluminum casket. (auth)

16810 (PPL-TR-61-22) RESEARCH ON THE EFFECTS OF MAGNETIC FIELDS ON THERMIONIC POWER

GENERATION. Progress Report No. 1. Alfred Schock and A. E. Kunen (Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.). Oct. 2, 1961. Contract Nonr-3285(00). 15p. (RAC-458; AD-264135)

Research concerned with a theoretical and experimental study of magneto-thermionic power generation is reported. This concept promises a number of advantages over conventional thermionic generators. Low pressure Cs diodes suffer from an undesirable size limitation, because self-induced magnetic fields reduce current transmission and hence, efficiency. Although this effect does not arise in the small devices tested to date, it becomes important in building larger generators. Analysis indicates that this problem can be virtually eliminated by the application of a longitudinal magnetic field. An experimental and theoretical study was initiated to verify the predicted magnetic field effects, and to examine their possible use in a-c generation. (auth)

16811 (PR-P-52) PHYSICS DIVISION PROGRESS REPORT, OCTOBER 1 TO DECEMBER 31, 1961. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 82p. (AECL-1472)

The Coulomb excitation of F^{19} was studied using 26-Mev F^{19} ions impinging on Al, Mg, and Si at 1.56, 1.46, and 1.35 Mev. The quadrupole and octupole transitions were very strong and imply cigar-like and pear-like oscillations for F^{19} in these low excitation states. In general research, development of methods for comparison of gamma energies with a precision of about 1 part in 10^5 is reported. Results of experiments concerning the properties of diffuse nuclear surfaces using low-energy particles were in fair agreement with results obtained using particles of high energy. A summary of various developments in electronics is included. (J.R.D.)

16812 (SCR-439) PRELIMINARY REPORT ON MAGNETOGASDYNAMIC ASPECTS. D. R. Chenoweth (Univ. of Illinois). Aug. 1961. Contract AT(29-1)-789. 64p. Sandia Corp. Monograph.

The fundamentals of magnetofluidmechanics are summarized. The magnetofluidmechanics literature on flow modification was reviewed. An analytical investigation was made of some highly restricted magnetofluidmechanic flows. The incompressible, electrically conducting flows were treated by continuum fluid mechanics using the assumption of small magnetic Reynolds number. Electrically conducting flow in the close vicinity of the axis of symmetry of a magnetic field similar to that of a single, circular current loop was studied under highly restrictive conditions. This example gave an indication of the effect which the magnetic field of a current loop has on the flow approaching it. Some magnetofluidmechanic vortex flows under the influence of nonuniform axial magnetic fields were also investigated. These flows displayed the dependence of the "effective" viscosity on electromagnetic parameters. (auth)

16813 (UTIA-78) THE DESIGNING OF DYNAMIC PRESSURE STAGES FOR HIGH-PRESSURE/HIGH-VACUUM SYSTEMS. B. W. Schumacher (Toronto. Univ. Inst. of Aerophysics). Aug. 1961. Contract AF49(638)-281. 54p. (AFOSR-88)

For firing electron or ion beams into gas spaces with pressures near one atmosphere passages were designed having free apertures of up to 1 mm in diameter. The vacuum in the beam forming region is maintained dynamically by constant pumping. It is shown in detail what pressures can be achieved with any given aperture and pump combination, and how multistage systems can be built having a short over-all length of the passage. Complete design diagrams are given. (auth)

16814 (FTD-TT-62-435) THE ROLE OF THE EMISSION CHANNEL IN AN ION SOURCE. S. N. Popov. Translated from Zhur. Tekh. Fiz., 31: 1431-8(1961). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 12299.

16815 SOME APPLICATIONS OF HYPERVIRIAL THEOREMS TO THE CALCULATION OF AVERAGE VALUES. J. H. Epstein and S. T. Epstein (Univ. of Nebraska, Lincoln). Am. J. Phys., 30: 266-8(Apr. 1962).

Hypervirial theorems are used to compute average values for the nonrelativistic hydrogenic atom, the isotropic harmonic oscillator, and the relativistic hydrogenic atom. In the latter case, new results are found. (auth)

16816 EXPERIMENTAL EVIDENCE FOR THE SECOND POSTULATE OF SPECIAL RELATIVITY. J. G. Fox (Carnegie Inst. of Tech., Pittsburgh). Am. J. Phys., 30: 297-300 (Apr. 1962).

The extinction theorem of dispersion theory, for which an elementary derivation is given, shows that an incident light wave is extinguished at the surface of a dielectric. This may mean that information about the velocity of light from a moving source would be lost if the light passed through intervening transparent, stationary material before it was measured. All measurements to verify the constancy of the velocity of light from moving light sources and mirrors and from extraterrestrial sources were made only after the light had passed through stationary material. Double stars, especially close binary pairs, are surrounded by a common envelope of gas which may contain enough matter to extinguish the direct light from the stars. Thus de Sitter's proof of the constancy of the velocity of light may not be conclusive. It is concluded that there may not exist any sure experimental evidence for the second postulate of special relativity. (auth)

16817 CALENDAR RECORD FOR THE INTERNATIONAL GEOPHYSICAL YEAR 1957-1958. A. H. Shapley and J. V. Lincoln, comps. Ann. Intern. Geophys. Yr., 16: 1-157(1962).

Charts and tables are given in calendar form for the period from July 1, 1957, to Dec. 31, 1958, including data on solar activity, geomagnetism, the ionosphere, the aurora, cosmic rays, and rockets and satellites. In addition, observations of auroral activity, polar-cap absorption events, quiet-day data, ionospheric indices, and other pertinent data are tabulated separately. (T.F.H.)

16818 IONIZATION EQUILIBRIUM EQUATION OF STATE. II. MIXTURES. Carl A. Rouse (Univ. of California, Livermore). Astrophys. J., 135: 599-615(Mar. 1962). (UCRL-5695-T(Pt. 3)).

A complete solution of Saha's equation was obtained for a mixture of monatomic gases in ionization equilibrium. The method involves iteration with respect to the electron concentration and can be applied to any number of elements with any number of ions in equilibrium. Results of three mixtures of H and He are given in tabular form. (auth)

16819 EMISSION SPECTRA OF HOT DENSE GASES. George T. Lalos and Gordon L. Hammond (Naval Ordnance Lab., White Oak, Md.). Astrophys. J., 135: 616-25(Mar. 1962).

A rapid gas-compression technique for producing hot dense gases is evaluated for extending studies of pressure effects on spectral lines to emission studies at high pressures. This technique has advantages over conventional absorption methods. Pressure-induced frequency shifts of Cr and Fe lines are given as a function of the relative density of the perturbing rare gas. Violet satellite bands in emission at high pressures are reported. (auth)

16820 KINETIC EQUATION DESCRIBING IRREVERSIBLE PROCESSES IN IONIZED GASES. Ta-you Wu (National Research Council, Ottawa) and R. L. Rosenberg. Can. J. Phys., 40: 463-519(Apr. 1962). (NRC-6766)

A formulation of the theory of irreversible processes in ionized gases is presented on the basis of the theory of Bogoliubov for neutral gases. In an extension of the work of Guernsey and Uhlenbeck, the kinetic equation is obtained for a spatially inhomogeneous system in an approximation to the "first order" in the interaction strength (e^2) and to all orders in the correlation effect (e^2/v, v being the specific volume). The equation, unlike the usual Vlasov equation, is not invariant with respect to time-reversal and shows a genuine "damping" in the sense of an irreversible approach to equilibrium. Discussions are given of the nature of a theory of irreversible processes, the "divergence difficulty," due to the long-range Coulomb forces, the Landau damping, the recent general theory of irreversible processes of Prigogine and Balescu, and the theory of ionized gases of Balescu. (auth)

16821 THE TRUE POTENTIAL ENERGY CURVES OF $A^1\Sigma^+$ STATE OF Li^7H^2, $B^3\Sigma_u^-$ STATE OF O_2, AND $A^3\Pi_g$ STATE OF C_2. N. L. Singh and D. C. Jain (Banaras Hindu Univ., Varanasi, India). Can. J. Phys., 40: 520-3(Apr. 1962).

Results, presented in graphical and tabular forms, are compared with previous curves (R. J. Fallon, et al., J. Chem. Phys. 33: 944(1960); R. W. Nicholls, Can. J. Phys. 38: 1705(1960); and R. W. Nicholls, et al., Combustion and Flame 3: 13(1959)). Satisfactory agreement is obtained in most cases. (L.N.N.)

16822 SCHMIDT NUMBER FOR NORMAL HYDROGEN AND PARA-HYDROGEN. S. C. Saxena and T. K. S. Narayanan (Rajasthan Univ., Jaipur, India and Atomic Energy Establishment, Trombay, India). Can. J. Phys., 40: 527-30(Apr. 1962).

Experimental and theoretical Schmidt numbers for normal and para-hydrogen were obtained from interdiffusion data of hydrogen-deuterium and ortho-para-hydrogen respectively. The Schmidt number decreases with increasing temperature and is fairly constant at 190 to 300°K. High-temperature values for para-hydrogen agree with classical values; variability is apparent at low temperatures. (L.N.N.)

16823 AUGER ELECTRONS OF LUTETIUM. Jacques Valentin (Faculté des Sciences, Orsay, France). Compt. rend., 254: 858-9(Jan. 29, 1962). (In French)

The experimental values of the energies and intensities of the Auger electrons are in satisfactory agreement with the theoretical values predicted by systematic studies. (tr-auth)

16824 SPECTROSCOPY OF THE FERROUS ION IN FERROUS CHLORIDE BY INELASTIC SCATTERING OF NEUTRONS. Serge Hautecler, Jovan Konstantinović, Daniel Cribier, and Bernard Jacrot (Centre d'Études Nucléaires, Saclay, France). Compt. rend., 254: 1026-8 (Feb. 5, 1962). (In French)

The decomposition of the ground level of Fe^{2+} in $FeCl_2$ was measured by inelastic scattering of cold neutrons. A transition of 165 ± 20 cm^{-1} was found which confirms the scheme of J. Kanamori. (tr-auth)

16825 METHOD PERMITTING THE DIRECT MASS SPECTROMETRIC MEASUREMENT OF THE ISOTOPIC RATIOS OF LEAD CONTAINED IN TRACES OF PITCHBLENDES WITHOUT PRELIMINARY CHEMICAL TREATMENT. Georges Durand (Centre de Recherches Radiogéologiques, Nancy, France). Compt. rend., 254: 1032-4 (Feb. 5, 1962). (In French)

A method permitting the direct mass spectrometric isotopic analysis of pitchblende in quantities of the order of several hundred micrograms was perfected. The spectrum of radiogenic lead contained in pitchblende was obtained directly. The fact that the analysis is made directly on the mineral suppresses the contaminations occurring in all chemical treatments. The only contaminations possible are those from the filament of the spectrometer source. (tr-auth)

16826 THERMO-ELECTRIC GENERATORS FOR THE CONVERSION OF SOLAR ENERGY TO PRODUCE ELECTRICAL AND MECHANICAL POWER. Kurt Katz (Westinghouse Electric Corp., Pittsburgh). Instr. Pract., 15: 1260-5(Oct. 1961).

The design and performance capability of thermoelectric generators for the conversion of solar energy are discussed. A detailed analysis of the parameters that effect the system economics is presented. The following topics are discussed: thermocouples and insulation, generator structure, performance, heat transfer, voltage, and cost analysis. (M.C.G.)

16827 PROCEEDINGS OF THE SEVENTH CONFERENCE ON MAGNETISM AND MAGNETIC MATERIALS, NOVEMBER 13-16, 1961, PHOENIX, ARIZONA. J. Appl. Phys., 33: Suppl. to No. 3, 1019-1394(Mar. 1962).

One hundred-forty-five papers are presented. Of these, 13 have been abstracted separately. The papers not abstracted separately cover such topics as magnetic devices, internal fields, thin films, spin configurations and anisotropy, magnetization, oxides, soft magnetic materials, rare earths, magnetic phenomena, antiferromagnetism and resonance, permanent magnets and micromagnetics, alloys and compounds, and crystals. (T.F.H.)

16828 HIGH MAGNETIC FIELD RESEARCH. Benjamin Lax (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys., 33: Suppl. to No. 3, 1025-9(Mar. 1962).

Highlights of a conference that included papers on research in plasma physics, low temperatures, solid state, and developments for generating high magnetic fields are reviewed. The plans and objectives of the National Magnet Laboratory and description of the physical facilities are presented. (auth)

16829 MODIFICATION OF SPIN SCREW STRUCTURE DUE TO ANISOTROPY ENERGY AND APPLIED MAGNETIC FIELD. Takeo Nagamiya (Osaka Univ.). J. Appl. Phys., 33: Suppl. to No. 3, 1029-36(Mar. 1962).

Developments in the theory of screw structure of spins, and of its modification by anisotropy energy and applied magnetic field, are reviewed. Reference is made to neutron diffraction work on rare-earth metals and $MnAu_2$. (auth)

16830 SUPERCONDUCTING MATERIALS AND HIGH MAGNETIC FIELDS. J. E. Kunzler (Bell Telephone Labs. Inc., Murray Hill, N. J.). J. Appl. Phys., 33: Suppl. to No. 3, 1042-8(Mar. 1962).

The discovery that Nb_3Sn remains superconducting in magnetic fields exceeding 88 kgauss while carrying current densities in excess of 100,000 amp/cm^2 stimulates the construction of superconducting magnets and the understanding of "hard" superconductivity. The critical current versus magnetic field characteristics of several materials are discussed and the justification of using such measurements on small samples as a basis for magnet design is presented. Nb–Zr alloys appear useful for magnets capable of fields as large as 80 to 100 kgauss while Nb_3Sn appears to be useful for fields of 200 kgauss. Fields as large as about 70 kgauss may be generated with Nb_3Sn magnets and 60 kgauss with Nb−Zr magnets. Fields exceeding 100 kgauss can be attained by augmenting the field produced by a superconducting Nb_3Sn magnet with the field from a solenoid. (auth)

16831 HYPERFINE FIELDS, SPIN ORBIT COUPLING, AND NUCLEAR MAGNETIC MOMENTS OF RARE-EARTH IONS. R. E. Watson (Avco Corp., Wilmington, Mass.) and A. J. Freeman. J. Appl. Phys., 33: Suppl. to No. 3, 1086-8 (Mar. 1962).

An investigation is presented of the problems of hyperfine fields, spin-orbit coupling, and the determination of nuclear magnetic moments, all of which are strongly dependent on the 4f charge distributions in the rare earths and strongly affect Mössbauer, NMR, paramagnetic resonance, and optical absorption measurements. The discussion is based on a set of conventional approximate nonrelativistic Hartree-Fock wave functions, which are determined for nine ions of the series. (auth)

16832 MAGNETIC HYPERFINE INTERACTION AND ELECTRONIC RELAXATION IN Sm^{3+} IN EuIG. M. E. Caspari, S. Frankel, and G. T. Wood (Univ. of Pennsylvania, Philadelphia). J. Appl. Phys., 33: Suppl. to No. 3, 1089-90 (Mar. 1962).

The attenuation and rotation of the integral correlation of the 1415 kev−122 kev γ-γ cascade following K capture in Eu^{152} was measured in neutron-irradiated polycrystalline samples from −25°C to above the Néel temperature with and without magnetizing field perpendicular to the counter plane. The existence of time-dependent hyperfine interactions of short relaxation times was taken into account in the evaluation of the average component of the effective hyperfine field $\langle H^z_{int} \rangle$ along the direction of the magnetizing field. The sign, magnitude, and temperature dependence of $\langle H^z_{int} \rangle$ was in agreement with that calculated from molecular field theory under the assumption that the electronic configuration of Sm^{152} following the K capture of Eu^{152} was that of the Sm^{3+} ion. The contribution to the magnetic hyperfine field arising from exchange between the 4f and inner core s electrons was found to be small compared with that from the orbital and spin moments of the 4f shell. The absolute magnitude of the hyperfine field was 4.7×10^6 gauss. Under the assumption that the time-dependent interactions were largely magnetic, the electronic relaxation time was found to be 3.2×10^{-12} sec at 400°C and varied inversely with the absolute temperature. (auth)

16833 THE ATOMIC MOMENTS AND HYPERFINE FIELDS IN Fe_2Ti AND Fe_2Zr. C. W. Kocher and P. J. Brown (Brookhaven National Lab., Upton, N. Y.). J. Appl. Phys., 33: Suppl. to No. 3, 1091-2(Mar. 1962). (BNL-5762)

The magnetic properties of Fe_2Ti and Fe_2Zr, intermetallic compounds with Laves-type structures, are studied using the techniques of neutron diffraction and nuclear resonance fluorescence (Mössbauer effect). Both compounds are ferromagnetic, with magnetic moments of 0.35 and 2.56 Bohr magnetons respectively at room temperature, and 0.92 and 3.12 Bohr magnetons respectively at liquid helium temperature. A magnetic form factor for the iron atoms in Fe_2Zr is determined. The nuclear resonance fluorescence experiments give measures of the magnetic fields at the iron nuclei. At room temperature, the field for Fe_2Zr is 190 ± 10 kgauss, while that for Fe_2Ti is less than 5 kgauss. The relation between the atomic magnetic moments and the magnetic fields at the nuclei is discussed. (auth)

16834 MAGNETIC STRUCTURE WORK AT THE NUCLEAR CENTER OF GRENOBLE. E. F. Bertaut (Centre d'Etudes Nucléaires, Grenoble, France), A. Delapalme, F. Forrat, G. Roult, F. de Bergevin, and R. Pauthenet. J. Appl. Phys., 33: Suppl. to No. 3, 1123-4(Mar. 1962).

Three structures are reported: FeRh is antiferromagnetic at low temperatures and ferromagnetic above 60°C; Fe has in both regions a high moment of about $3\mu_B$, and Rh has a definite moment in the ferromagnetic region of about $0.6\mu_B$. Cr_3Se_4, a nonstoichiometric compound with ordered holes, has a magnetic structure closely related to that of $MnBr_2$. $UCoO_4$, an isomorph of $UMgO_4$, is antiferromagnetic, having Co−O−O−Co interactions and a Néel temperature of 12°K. (auth)

16835 NEUTRON DIFFRACTION STUDY OF MAGNETIC ORDERING IN THULIUM. W. C. Koehler, J. W. Cable, E. O. Wollan, and M. K. Wilkinson (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 33: Suppl. to No. 3, 1124-5(Mar. 1962).

Neutron diffraction measurements are made on a single-crystal specimen of metallic thulium at temperatures from 293 to 4.2°K. In the temperature range between 38 and 56°K the magnetic structure is similar to the high-temperature form of erbium, namely, a simple oscillating-z-component-type antiferromagnetic structure. Below 38°K additional satellite reflections are observed in the diffraction patterns, from which it is inferred that the sinusoidal modulation is modified below this temperature. At 4.2°K the normal lattice reflections show an increase in intensity in zero field, which is consistent with a mean magnetic moment per thulium atom of approximately one Bohr magneton directed parallel to the c axis. The low temperature magnetic structure proposed for thulium is one in which the moments are parallel to the c axis of the crystal but change their orientations according to the sequence 4, 3, 4, 3 ···. The fundamental period of the modulation remains constant over the entire range of temperature at a value corresponding to 3.5 a_3 periods. (auth)

16836 NEUTRON DIFFRACTION STUDIES ON EUROPIUM METAL. C. E. Olsen, N. G. Nereson, and G. P. Arnold (Los Alamos Scientific Lab., N. Mex.). J. Appl. Phys., 33: Suppl. to No. 3, 1135-6(Mar. 1962).

Neutron diffraction investigations are made on europium, which show the metal to be antiferromagnetic with a Néel temperature of 87 ± 1°K. The observed magnetic reflections can be interpreted in terms of a helical spin structure having a pitch of 3.60 a_0 and a helix axis in the (100) direction or an amplitude modulated structure in the (100) direction having a periodicity of 3.60 a_0. Between 20 and 87°K, within experimental error, the intensities of the magnetic reflections are proportional to $(T_N - T)_{1/4}$, where T_N is the Néel temperature. The helix pitch is not a function of temperature. (auth)

16837 RARE-EARTH RUTHENATES. R. Aléonard, E. F. Bertaut, M. C. Montmory, and R. Pauthenet (Institut Fourier, Grenoble, France). J. Appl. Phys., 33: Suppl. to No. 3, 1205(Mar. 1962).

In the pyrochlore compounds $Ru_2M_2O_7$ (where M = Pr, Nd, Gd, Tb, Dy, Ho, or Y), Ru(IV) contributes 1 to the Curie constant, instead of the value 3 expected for a d^4 state with g = 2 and j = 2. (auth)

16838 ALLOYS OF THE FIRST TRANSITION SERIES WITH Pd AND Pt. S. J. Pickart (Naval Ordnance Lab., Silver Springs, Md. and Brookhaven National Lab., Upton, N. Y.) and R. Nathans. J. Appl. Phys., 33: Suppl. to No. 3, 1336-8(Mar. 1962). (BNL-5740)

Neutron diffraction measurements on the ordered fcc alloys $FePd_3$, $MnPt_3$, and $Cr_{0.3}Pt_{0.7}$ support the existence of localized magnetic moments on the Pd and Pt atoms. The individual moments are determined by combining the difference in moment, based on reasonable assumptions about the magnetic form factors, with the total moment as determined from magnetization measurements. The results for $FePd_3$ are consistent with suggestions based on magnetization measurements; at 300°K Fe has a moment of $2.73 \pm 0.13\ \mu_B$ and Pd of $0.51 \pm 0.05\ \mu_B$. In $MnPt_3$ at 77°K a small moment on the Pt is observed ($0.17 \pm 0.04\ \mu_B$), with most of the moment residing on the Mn ($3.60 \pm 0.09\ \mu_B$). At room temperature the magnetic ordering in $Cr_{0.3}Pt_{0.7}$ is ferrimagnetic, with a Cr moment (if assumed equal on both Cr and Pt sites) of $2.56 \pm 0.10\ \mu_B$ and a Pt moment of 0.47 ± 0.05 oppositely aligned. (auth)

16839 NEUTRON DIFFRACTION INVESTIGATIONS OF FERROMAGNETIC PALLADIUM AND IRON GROUP ALLOYS. J. W. Cable, E. O. Wollan, W. C. Koehler, and M. K. Wilkinson (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 33: Suppl. to No. 3, 1340(Mar. 1962).

In order to account for the magnetic properties of alloys it becomes important to determine the individual magnetic moments of the constituent atoms. This determination can be accomplished by means of neutron diffraction and magnetic induction measurements. Such measurements are made on the ferromagnetic alloys Pd_3Fe, PdFe, Pd_3Co, PdCo, Ni_3Co, and NiCo. The average moment values are obtained from magnetic induction measurements while the differences in the atomic moments are determined from either the ferromagnetic diffuse scattering by the disordered alloys or the superlattice reflections by the ordered alloys. (auth)

16840 MAGNETIC CHARACTERISTICS OF HYDROGENATED HOLMIUM. Y. Kubota and W. E. Wallace (Univ. of Pittsburgh). J. Appl. Phys., 33: Suppl. to No. 3, 1348-9 (Mar. 1962).

Various physical and chemical properties of the lanthanide hydrides suggest that they are saline in nature, the hydrogen existing as a negatively charged ion. These properties further suggest that the anionic charge is obtained from the conduction band of the lanthanide and that in the fully hydrogenated metal the conduction band is completely depopulated. Since coupling of the lanthanides occurs via the conduction electrons, this should lead to considerable suppression of the interactions in the hydrides compared to the element, but an unchanged effective atomic moment. To determine whether this is the case, susceptibility measurements are made on nine Ho—H alloys. These show for the dihydride, which still contains some conduction electrons, a Néel point at around 8°K (instead of 135°K for the element), whereas for the trihydride, which lacks conduction electrons, no Néel point is observed down to 4°K. Susceptibilities of the hydrides above about 15°K obey the Curie-Weiss law with a much smaller Weiss constant than that for elemental holmium. The atomic moment is found, however, to be virtually unaffected by hydrogenation. (auth)

16841 REDUCTION OF CONTAMINATION IN REFLECTION ELECTRON DIFFRACTION. Eiji Yoda and Benjamin M. Siegel (Cornell Univ., Ithaca, N. Y.). J. Appl. Phys., 33: 1419-22(Apr. 1962).

The rate at which contamination forms on surfaces exposed to electron beams in reflection electron diffraction was investigated for electropolished single crystals of copper and cleavage faces of alkali halide crystals by observing the decrease of the intensity in the diffraction pattern. It was found that a cold chamber at liquid nitrogen temperatures surrounding the specimen reduces the contamination rate on copper by an amount directly proportional to the solid angle through which the specimen is exposed to the vacuum system, and at the smallest aperture lowers the rate by as much as 2 orders of magnitude. Color centers were produced in the alkali halide crystals exposed to the electron beam. The resultant imperfections in the crystal lattice apparently affected the diffraction spot intensity, making measurement of contamination rates by this method unsatisfactory. (auth)

16842 ELECTRON SPACE-CHARGE-LIMITED OPERATION OF CESIUM THERMIONIC CONVERTERS. E. N. Carabateas (Thermo-Electron Engineering Corp., Waltham, Mass.). J. Appl. Phys., 33: 1445-9(Apr. 1962).

Experimental results from a cesium thermionic converter show that at low emitter temperatures and high cesium pressures, the output current approaches an asymptotic value as the emitter is made more and more negative with respect to the collector. With further decrease in voltage the current jumps to much higher values. The assumption was made that the operation of the converter under these conditions is electron space-charge-limited and that in the high current mode, collision ionization is present. A quantitative analysis of this electron space-charge-limited operation is presented, and an expression for the limiting value of the output current is obtained. A method is outlined by which the difference in emitter and collector work functions can be found from an experimental current-voltage characteristic and conversely such a characteristic can be plotted if sufficient information is given. This method is applied to experimental I-V curves obtained from a parallel plate converter with a tantalum emitter. From these curves the emitter work function and the true saturation current were estimated. These values of work function are approximately 0.5 v less than extrapolated values obtained from other experiments for cesium on tantalum. With the assumption that ions are introduced in the interelectrode spacing only by surface ionization, the magnitudes of the emitter and collector sheaths are computed at different points of the I-V curve. (auth)

16843 LANDAU DAMPING OF SPACE-CHARGE WAVES. J. Berghammer (David Sarnoff Research Center, Princeton, N. J.). J. Appl. Phys., 33: 1499-1504(Apr. 1962).

The current modulation excited by a sinusoidal voltage across a narrow-gap resonator on an electron beam with a Maxwellian distribution of velocities is treated on the basis of the linearized Boltzmann equation without collisions. The numerical part of the analysis reveals that the current modulation as function of distance has the form of a damped sinusoid, with finite minima, and approaches a constant level at large distances. These results are in qualitative agreement with experimental observations. The analytical results show that the fast space-charge wave of monovelocity theory is replaced by a continuum of waves (for $\omega_p < \omega$). This fast-wave packet decays with distance because of phase mixing, so that only the slow space-charge wave survives at large distances. The spatial decay of the fast-wave packet is the equivalent in multivelocity beams of temporal Landau damping in stationary plasmas. (auth)

16844 WIRE EXPLOSIONS IN AIR AND IN VACUO. G. S. Rose (National Research Council, Ottawa). J. Appl. Phys., 33: 1604-6(Apr. 1962).

Wire explosions in rail-type plasma guns in vacuo are discussed and illustrated; oscillograms are presented. Expanding cylindrical shock waves followed by regions of reduced pressure behind the contact surfaces are produced by the explosions. Variation of dwell time with wire diameter was measured and data are presented in graphical form. In a vacuum, the dwell time is reduced to 0.15 μsec, which corresponds to that observed for thicker wires in air. (L.N.N.)

16845 ON THE USE OF NONINTEGRAL EXPONENTS IN ELLIPTICAL COORDINATE WAVE FUNCTIONS, WITH SPECIAL REFERENCE TO THE HYDROGEN MOLECULE-ION. Murray Geller and Oliver G. Ludwig (Carnegie Inst. of Tech., Pittsburgh). J. Chem. Phys., 36: 1442-4(Mar. 15, 1962).

Introduction of arbitrary powers of the elliptical coordinate μ is shown to give a better approximate wave function for the hydrogen molecule-ion than any previous function of comparable complexity. The three-parameter two-configuration function $\psi = N\mu^n e^{-\alpha\mu}(1 + b\nu^2)$ is found to give an energy of −0.602566 au and an equilibrium internuclear separation of 1.9956 a_0 compared with the results for $n = 0$ of −0.602386 au and 1.9966 a_0, respectively, and with the exact values of −0.60263 au and 2.0 a_0, respectively. This agreement is maintained over a range of internuclear distances. In the Appendix, discussion is given of various methods for computing kinetic energy integrals, and a special difficulty is pointed out that arises when functions in prolate spheroidal coordinates are employed. (auth)

16846 INITIAL KINETIC ENERGY DISCRIMINATION EFFECTS IN CROSSED-FIELD ION SOURCES. Norman D. Coggeshall (Gulf Research and Development Co., Pittsburgh). J. Chem. Phys., 36: 1640-7(Mar. 15, 1962).

Previously developed differential equations for crossed-field trajectories are particularly suitable for investigating the characteristics of the orbits in crossed-field ion sources of mass spectrometers. At low repeller voltages there can be enormous initial kinetic energy discrimination due to the cycloidal orbits turning around before reaching the plane of the first slit. Energy relations for collectible orbits will be presented. A transformation of angle may be made between the isotropic distribution of initial velocity components to the anisotropic distribution of orbits that applies in the beam defined by the first slit. The latter will depend upon the operating conditions and may be studied by deflecting the beam across the exit slit by varying the deflection voltages. The signal reaching the detector then represents a progressive lateral sampling of the beam. The width and maximum intensity in this beam are functions of operating conditions and it is shown how very misleading results may be obtained depending upon how the exit slit samples this beam. Collection efficiency can be defined and set up as an integral of a function of the projected initial kinetic energy components on the plane of motion. The area under the curve obtained by progressively pushing the beam from the first slit across the exit slit represents the flux of ions collected by the first slit. This is dependent on operating conditions and may be conveniently used to investigate initial kinetic energies. (auth)

16847 CONSISTENCY AND THE FIFTH VIRIAL COEFFICIENT FOR A HARD-SPHERE GAS. G. H. A. Cole (Clark, Chapman and Co., Ltd., Durham, Eng.). J. Chem. Phys., 36: 1680-2(Mar. 15, 1962).

The modified superposition approximation $g^{(3)}(r,s,t) = g^{(2)}(r)g^{(2)}(s)g^{(2)}(t)[1 + X_1n + X_2n^2]$ (where $g^{(3)}$ is the triplet distribution, $g^{(2)}$ the pair distribution, n the number density, and (r,s,t) are the particle separation distances) is used in conjunction with the Born-Green-Yvon equation of the classical theory of fluids in the calculation of the fifth virial coefficient E for a gas of hard spheres. The values of E derived directly from the virial theorem and alternatively from compressibility arguments are reconciled through a suitable choice of X_2. On the assumption X_1 = constant it is found for hard spheres that $X_1 = 0.1014b$ and $X_2 = -0.0424b^2$ (b = four times a molecular volume) ensures consistency as far as the fifth virial coefficient. The consistent value of E under this approximation is $+0.0242b^4$. The validity of the arguments is considered. (auth)

16848 DIRECT GENERATION OF ELECTRICITY. D. Gabor (Imperial Coll. of Science and Tech., London). Mech. World Eng. Rec., 141: 274-5(Aug. 1961).

The progress being made in the development of a thermionic generator (diode) for the direct generation of alternating current from heat is discussed. It is estimated that the efficiency of this type of generator might be reduced from 30 to 22% as compared to direct current generation, but this drop in efficiency might be outweighed by the reduction in the cost of the plant compared with conventional a-c generators. The design of Professor Gabor's diode is shown and described. (N.W.R.)

16849 ANOTHER FORM OF QUANTUM ELECTRODYNAMICS. Peter Rastall (Univ. of British Columbia, Vancouver). Nuclear Phys., 30: 664-79(Mar. 1962). (In English)

The field equations of electrodynamics are modified by adding the gradient of a scalar operator to the current density. The theory is then quantized without any of the usual difficulties. The S-matrix takes its customary form in the limit when the added term tends to zero. (auth)

16850 "NEW TAMM-DANCOFF" APPROXIMATION AND SUPERCONDUCTIVITY. H. Mitter and K. Yamazaki (Max-Planck-Institut für Physik und Astrophysik, Munich). Nuclear Phys., 30: 683-7(Mar. 1962). (In English)

The lowest Tamm-Dancoff approximation to the two-point function of the "reduced" Hamiltonian in the Bardeen-Cooper-Schrieffer theory is shown to satisfy the whole set of Tamm-Dancoff Equations of arbitrary order, provided the volume of the system is large. Similar approximations are discussed. (auth)

16851 EQUATIONS GOVERNING THE PROPAGATION OF SECOND-ORDER CORRELATIONS IN NON-STATIONARY ELECTROMAGNETIC FIELDS. Y. Kano (Univ. of Rochester, N. Y.). Nuovo cimento (10), 23: 328-38(Jan. 16, 1962). (In English)

The results derived by E. Wolf and P. Roman relating to the propagation of second-order correlations in electromagnetic fields are generalized to the case of a non-stationary field containing currents and charges. The basic differential equations relating the correlations are derived. They fall into two groups, one contains only differential equations of the first order, but involves certain parameters that seem difficult to be determined experimentally. When these quantities are eliminated a second set of equations is obtained. Equations of this set are of a higher order but they contain only the electric and the magnetic correlation tensors and a tensor characterizing the correlation in the electric currents. (auth)

16852 SOLUTION OF THE BOLTZMANN EQUATIONS FOR STRONG SHOCK WAVES BY THE TWO-FLUID MODEL. P. Glansdorff (Université Libre, Brussels). Phys. Fluids, 5: 371-9(Apr. 1962).

The structure of a plane shock wave is studied by an extension to the gas dynamics of the two-fluid model already introduced in the superfluidity theory. The classical form is used for the linearization of two Boltzmann equations, and restricted to the first approximation. This is different from Mott-Smith's solutions which cannot be derived by linearization from a single Boltzmann equation, and as a result has to be introduced arbitrarily. Six equations of change for conservative quantities (mass, momentum, energy) are obtained which makes possible the solution of the wave problem without having to introduce other equations of change. Calculations are made using the elastic-sphere model. Comparison with observations made on argon gives very satisfactory results. The solutions tend asymptotically to a stationary solution corresponding to a Mach number equal to infinity, and to a shock wave thickness 11.4 times the mean free path ahead of the shock for all monatomic gases. This establishes the possibility of coexistence of two fluids in nonequilibrium, even thermal, in shock waves with large gradients. (auth)

16853 COLLISION INTEGRALS FOR THE TRANSPORT PROPERTIES OF DISSOCIATING AIR AT HIGH TEMPERATURES. K. S. Yun and E. A. Mason (Univ. of Maryland, College Park). Phys. Fluids, 5: 380-6(Apr. 1962).

Collision integrals (transport cross sections) for atomic and molecular interactions of importance in high-temperature air are calculated based on accurate force laws which have recently become available. The tabulations include the collision integrals for diffusion, viscosity, and thermal conductivity, and the collision integral ratios A*, B*, and C* needed for mixture calculations, and cover the range from 1000 to 15,000°K for the major interactions $N-N$, $O-O$, $N-O$, $N-N_2$, $O-O_2$, $O-N_2$, N_2-N_2, O_2-O_2, and N_2-O_2. Average potential energy functions, but no collision integrals, are given for the minor interactions $O-NO$, O_2-NO, N_2-NO, and $NO-NO$. The calculations all refer to atoms and molecules in their ground states only. Calculational errors are estimated to be about 5% over the temperature range, but may occasionally rise as high as 10%. The relative magnitudes of the average collision integrals are discussed briefly for their bearing on the qualitative behavior of the corresponding gas mixtures, and on the assessment of the errors involved in some approximations commonly used in calculations of transport properties of air. (auth)

16854 MAGNETOHYDRODYNAMICS AT SMALL MAGNETIC REYNOLDS NUMBERS. Mahinder S. Uberoi (Univ. of Michigan, Ann Arbor). Phys. Fluids, 5: 401-6(Apr. 1962).

Two problems are considered, each of which represents a class of flows. In the first problem the motion is induced by passage of electric current through an incompressible viscous electrically conducting fluid contained in an insulated axisymmetric tube. The solution is obtained in closed form by assuming small Reynolds numbers such that the electromagnetic forces are balanced by viscous forces. In the second problem incompressible inviscid electrically conducting fluid flows through an axisymmetric tube and the flow is modified due to passage of electric current. The complete solution of the resultant rotational flow is obtained in closed form for small changes in tube diameter. At appreciable rates of current flow the fluid in the central part of a contracting tube behaves as if the tube were expanding; the opposite is true for an expanding tube. This is shown to be the case quite generally even when the assumption of small magnetic Reynolds number is dropped. Further, at large rates of current flow there may develop a secondary flow. (auth)

16855 MAGNETOHYDRODYNAMIC THEORY OF LUBRICATION. W. Fucks and J. Ulenbusch (Technische Hochschule, Aachen). Phys. Fluids, 5: 498-9(Apr. 1962).

The magnetohydrodynamic theory of the two-dimensional flow between plane walls of small inclination is applied to the problem of lubrication of bearings. Equations are given for boundary conditions. The arrangement of guide surface and slide block in relation to the external magnetic field are shown. Results are graphically shown of the pressure distribution over slide block for mercury at 60°C and lubricating oil at 60 and 85°C with respect to constant external magnetic field. (N.W.R.)

16856 THEORY OF NONTHERMAL IONIZATION IN CESIUM DISCHARGES. David J. BenDaniel and Stephen Tamor (General Electric Research Lab., Schenectady). Phys. Fluids, 5: 500-1(Apr. 1962).

A semiquantitative theory of nonthermal ionization in cesium-helium discharges is briefly outlined. The application of the Maxwell and Saha equations to the theory are indicated. (N.W.R.)

16857 MODEL PROPOSALS FOR SOME ABSORPTION BANDS OF COLORED AND UNCOLORED STRONTIUM FLUORIDE CRYSTALS. Hans Karras. Phys. Status Solidi, 1: 160-8(1961). (In German)

The preparation of crystals from very pure material is discussed. The experimental results suggest that the green spectrum of additive coloration is characteristic for intrinsic defects. The form and position of the two principal bands are calculated with the aid of the relations of Smakula and Mollwo. The ratios of the positions are found to be given by simple expressions. A proposal is made for geometrical representations of chemical and intrinsic defects before and after the additive coloration. An attempt is made to relate the geometrical models and the bands. For the two principal bands the model proposed involves ideas familiar from the study of color centers. (auth)

16858 ELECTROLUMINESCENCE OF CdS SINGLE CRYSTALS. K. W. Boeer, H. J. Haensch, and H. Obernik (Humboldt Universität, Berlin and Physikalisch-Technisches Institut der Deutschen Akademie der Wissenschaften, Berlin). Phys. Status Solidi, 1: 352-65(1961). (In German)

The electroluminescence (EL) of CdS single crystals in d-c fields was investigated. Various types of EL are found, depending on the current, and they are described with the aid of photographs. The authors have observed channel and spot-like green luminescence and strongly localized dots of yellow luminescence. The dependence of the EL on crystal imperfections and on the field distribution, particularly in relation to electro-optical effects, are studied. The spectral distribution of the green EL was also measured. (auth)

16859 THERMOLUMINESCENCE OF CaF_2 CRYSTALS. P. Goerlich, H. Karras, A. Koethe, and K. Kuehne. Phys. Status Solidi, 1: 366-85(1961). (In German)

The thermoluminescence of three types of CaF_2 crystals was measured: type I: natural crystals (found near Ilmenau); and type II: synthetic undoped crystals; (a) prepared from natural material; and (b) prepared from synthetic material of highest purity; type III: synthetic doped crystals prepared from synthetic material of highest purity. For each crystal the spectral composition of the luminescence and glow curves of some luminescence bands were measured. The added impurities give rise to characteristic spectra and glow maxima. Energies of trapping levels were calculated for several glow maxima by means of well-known procedures. (auth)

16860 ADDITIVE COLORING OF STRONTIUM FLUORIDE. K. W. Boeer and K. H. Zschauer (Humboldt-Universität, Berlin and Physikalisch-Technisches Institut der Deutsche Akademie der Wissenschaften, Berlin). Phys. Status Solidi, 1: K36-7(1961). (In German)

In studies of the green luminescence of CdS single crystals at 1000 v imposed voltage and electrode distances of 2 mm, it was observed that the tongue-shaped luminescence was crossed by dark streaks parallel to the anode boundary. The streaks move toward the cathode and have a width of 0.1 mm. The origin of these streaks is discussed. (J.S.R.)

16861 ON THE RANGE OF ENERGY PROPAGATION IN PHOSPHORS. Gy. Gergely (Research Inst. for Telecommunication, Budapest). Phys. Status Solidi, 1: K49-K52 (1961). (In English)

Some aspects of energy transfer and propagation are discussed in luminescent crystals in the case of host crystal excitation. For ZnS type crystals, the Schön-Klasens model is used, however, the considerations may be valid for certain special cases of the Rose-Bube model. (J.S.R.)

16862 PHOTOCHEMICAL REACTIONS AND QUENCHING IN CdS SINGLE CRYSTALS. W. Borchardt (Humboldt-Universität, Berlin). Phys. Status Solidi, 1: K52-8(1961). (In German)

It has been proposed that the conductivity decrease induced by photochemical reactions can be ascribed to a supplementary recombination which was considered in the reaction kinetics model as an effective recombination center. In order to obtain data on the mechanism of this supplementary recombination, investigations were made on the quenching of the photoconductivity by infrared radiation and the spectral distribution and the intensity dependence of the photoconduction in connection with photochemical reactions. The quenching spectra of very pure CdS crystals and of Fe-activated crystals at 20 and −180°C were measured with and without photochemical reaction products and without photochemical reaction products with reduced excitation intensity. (J.S.R.)

16863 THE LUMINESCENCE BEHAVIOR OF CdS SINGLE CRYSTALS ABOVE ROOM TEMPERATURE. K. Albers (Humboldt-Universität, Berlin). Phys. Status Solidi, 1: K58-K61(1961). (In German)

The luminescence of a number of CdS single crystals was investigated, and the temperature dependence of the intensity of the red band was measured between −180 and 150°C. The intensity decreased rapidly with increased temperature, and this intensity decrease was irreversible. The spectral distribution of the luminescence before and after illumination at high temperatures was measured, and a typical curve is shown. The green luminescence was investigated in a similar manner, and the results showed that the intensity was reduced as in the red band. (J.S.R.)

16864 THERMODYNAMIC PROPERTIES OF THE MONO-ATOMIC LINEAR CHAIN. Jean Pirenne and Pierre Renson (Universite, Liège). Physica, 28: 233-50 (Mar. 1962). (In English)

The analytical and numerical study of the thermodynamic properties of a regular mono-atomic linear chain leads to a criticism of Blackman's results concerning the specific heat curve and the Debye temperature; it presents information for the study of the same properties of a disordered isotopic linear chain. (auth)

16865 FREEZING AND LAMBDA CURVES OF ^{3}He–^{4}He MIXTURES. C. Le Pair, K. W. Taconis, R. De Bruyn Ouboter, and P. Das (Kamerlingh Onnes Laboratorium, Leiden). Physica, 28: 305-6(Mar. 1962). (In English)

A discontinuity was found in the slope of the freezing curves at the junction of the λ curve and the freezing curve for the mixtures. The λ line illustrated was determined by observing the rapid change in volume near the λ point. At low temperatures, the freezing pressure of the mixtures becomes lower than that for pure He^4. Data are presented in graphical form. (L.N.N.)

16866 A NEW CALCULATION OF ELECTRON SCATTERING CROSS SECTIONS AND A THEORETICAL DISCUSSION OF IMAGE CONTRAST IN THE ELECTRON MICROSCOPE. R. E. Burge and G. H. Smith (King's Coll., Newcastle upon Tyne, Eng.). Proc. Phys. Soc. (London), 79: 673-90(Apr. 1, 1962).

The results from the newer atomic models are incorporated into the theory of single-electron scattering as applied to electron microscopy. The new method of calculation avoids the rigid expressions used by Lenz for the potential distribution within an atom and the atomic radius by using directly the values of the atomic scattering factors for x rays and for electrons evaluated from the latest atomic models. The variations of the elastic, inelastic, and total mass-scattering cross sections and differential atomic scattering cross sections with the accelerating voltage of the electron beam, the angular aperture of the objective lens, and the atomic number of the amorphous specimen giving rise to the scattering, are discussed in detail for both the newly developed theory and the Lenz theory in its two interpretations. Most of the results are given for accelerating voltages in the range 20 to 100 kv but a few results for the new theory are given for voltages of 500 and 1000 kv. The differences and similarities between the results of the two theories are discussed and a section is included on the agreement between theoretical and experimental parameters describing the image contrast. The theoretical values of the total mass-scattering cross sections are appreciably higher than the experimental values, but the theoretical predictions about the variations of the cross sections with the atomic number of the scattering element and the instrumental parameters are in general agreement with the experimental results. Methods are suggested by which the basis of the new calculations of the cross sections may be improved. (auth)

16867 SOFT X-RAY EMISSION SPECTRA FROM Cu$_3$Au. J. A. Catterall and J. Trotter (National Physical Lab., Teddington, Middx., Eng.). Proc. Phys. Soc., (London), 79: 691-6(Apr. 1, 1962).

Emission spectra were obtained from the alloy Cu$_3$Au in both the ordered and disordered state. The spectra obtained were the transitions valence → M$_{23}$ for copper, and O$_{45}$ → N$_6$ and O$_{45}$ → N$_7$ for gold. No changes in these spectra were observed with ordering of the alloy, and the alloy spectrum may be obtained by simple addition of the spectra of the pure metals. These observations are discussed in relation to the other physical properties. (auth)

16868 THE NEAR-ADIABATIC CRITERION IN CHARGE TRANSFER COLLISIONS. J. B. Hasted and A. R. Lee (Univ. Coll., London). Proc. Phys. Soc. (London), 79: 702-9(Apr. 1, 1962).

Coulomb and polarization energy corrections to the near-adiabatic criterion were calculated for the available cross section function data on one- and two-electron transfer collisions. In the adiabatic maximum rule the product of adiabatic parameter and number of electrons transferred is found to have a mean value of 7 Å, the probable errors being reduced. The recombination energies of the hydrogen molecular ion are discussed in the light of its collisions with rare gas atoms. (auth)

16869 EFFECT OF COULOMB REPULSION BETWEEN CHARGED ATOMIC SYSTEMS ON EXCITATION AND IONI-

ZATION CROSS SECTIONS. D. R. Bates and Anne H. Boyd (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 79: 710-16(Apr. 1, 1962).

It is shown that the neglect of the Coulomb repulsion between colliding ions introduces negligible errors in calculations on excitation and ionization cross sections except in the very early part of the (cross section)–(impact energy) curves. For example, in the case of $He^+(1s) + He^{2+} \rightarrow He^+(2s) + He^{2+}$ the fractional correction which should be made to the first Born approximation to the cross section is as low as 5% at the smaller of the two energies at which the cross section is one quarter the maximum, and is as low as 0.3% at the energy at which the cross section passes through the maximum. The corresponding fractional corrections for the 1s–2p transitions are even less. (auth)

16870 THE SCATTERING OF LOW ENERGY ORTHO-POSITRONIUM BY HELIUM ATOMS. P. A. Fraser (Univ. of Western Ontario, London, Can.). Proc. Phys. Soc. (London), 79: 721-31(Apr. 1, 1962).

An approximate calculation is made on the elastic scattering ($l = 0$) of low-energy ortho-positronium by helium atoms. The resulting cross section is 17.7 πa_0^2 at zero energy, which is an order of magnitude smaller than the value for the zero-energy cross section for the similar problem with hydrogen reported in 1961 by Fraser. Above 2 ev, however, the cross sections for the two problems are similar in magnitude and behavior. Exchange is fully allowed for in the trial wave function, but excitation and polarization effects are neglected. The use of the simplest variational helium ground-state wave function in the over-all trial wave function leads to difficulty in setting up the problem on a consistent variational basis. However, internal consistency and the results of other workers on electron-helium problems, suggest that the values are a fair approximation. (auth)

16871 DISSOCIATION AND IONIZATION OF HYDROGEN IN HIGH FREQUENCY DISCHARGES. C. C. Goodyear and A. von Engel (Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 79: 732-40(Apr. 1, 1962).

An examination of the collision processes in the electrodeless discharge of a hydrogen or deuterium ion source shows that the high yield of atomic ions implies a two-stage process, namely dissociation of molecules by electron collision and subsequent ionization of the atoms. A theoretical study of the balance between production and loss of atoms, together with measured values of plasma density and electron temperature, predicts a high degree of dissociation for a certain range of pressure. The energy balance is also examined and shows that most of the power maintaining the discharge apparently produces 10 ev ultra-violet quanta from excited atoms. (auth)

16872 THE TRUE POTENTIAL ENERGY CURVES OF THE EXCITED STATES OF LiH AND RbH MOLECULES. N. L. Singh and D. C. Jain (Banaras Hindu Univ., Varanasi, India). Proc. Phys. Soc. (London), 79: 753-7(Apr. 1, 1962).

The true potential energy curves of the excited states of LiH and RbH molecules were obtained by the Rydberg-Klein-Rees method. An analytical method was developed for evaluating the phase integral. On the application of this method to a number of vibrational levels, it was observed that the true potential energy curves satisfy the quantization condition very well. In the case of RbH, the phase integrals were evaluated by a graphical method as well. (auth)

16873 THE VOLUME MAGNETOSTRICTION OF GADOLINIUM METAL NEAR THE CURIE TEMPERATURE. J. Tudor Davies (Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 79: 821-30(Apr. 1, 1962).

Using the constant-coupling model of a ferromagnet the magnetization and volume magnetostriction are calculated around the Curie temperature and at high temperatures. For gadolinium this theory provides a reasonable link between the measured values of the magnetostriction and the pressure dependence of the Curie temperature. (auth)

16874 THERMAL CONDUCTIVITY OF TANTALUM AND NIOBIUM BELOW 1°K. A Connolly and K. Mendelssohn (Oxford Univ.). Proc. Roy. Soc. (London), 266: 429-39 (Mar. 27, 1962).

The thermal conductivity, K_s, of superconductive tantalum and niobium was measured between 0.2 and 1.2°K, and for one niobium specimen between 0.2 and 4.2°K. Large maxima in K_s occur in all three cases at $\sim 0.2T_c$ and K_s was analyzed into its electronic and lattice components K_{es} and K_{gs}. Agreement between experiment and theory is good for tantalum between $T = 0.5T_c$ and $T = T_c$, where K_{gs} is small. Below $0.5T_c$ conduction by phonons becomes appreciable. From the curves of K_{gs} against T the width of the energy gap at 0°K was deduced, giving $(2\epsilon_0 =)3.8 \pm 0.2kT_c$ for tantalum and $(2\epsilon_0 =)3.5 \pm 0.2kT_c$ for niobium. (auth)

16875 MEASUREMENT IN QUANTUM MECHANICS. II. REDUCTION OF A WAVE PACKET. Hitoshi Wakita (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 27: 139-44(Jan. 1962). (In English)

The theory of measurement is interpreted without an abrupt and noncausal change of a state, namely, without "reduction of a wave packet," in the framework of quantum mechanics. Though a process of measurement is causal in the usual quantum-mechanical sense, it is possible to utilize the concept of the "reduction of a wave packet" without any loss of compatibility. The Stern-Gerlach experiment is studied to show that the present interpretation is consistent with experiment. (auth)

16876 THE SINGULARITY OF PROPAGATORS IN FIELD THEORY AND THE STRUCTURE OF SPACE-TIME. [PART] II. Yoshiro Takano (Yokohama National Univ., Japan). Progr. Theoret. Phys. (Kyoto), 27: 212-13 (Jan. 1962). (In English)

It is shown that previous results (Y. Takano, Prog. Theoret. Phys., 26: 304(1961)) support the interpretation that the manifestly covariant local theory with indefinite metric is equivalent to a non-local theory with definite metric. The four-dimensional description is sacrificed. (L.N.N.)

16877 QUANTIZATION OF FLUX IN SUPERCONDUCTORS. Kazumi Maki (Kyoto Univ.) and Toshihiko Tsuento. Progr. Theoret. Phys. (Kyoto), 27: 228-9(Jan. 1962). (In English)

It is shown that flux quantization in superconducting cylindrical tubes follows directly from a microscopic theory (L. P. Gorkov, J. Exptl. Theor. Phys., 34: 735 (1958)). (L.N.N.)

16878 THE HYPERFINE STRUCTURE OF THE FORBIDDEN Hg II LINE λ 2815 Å AND THE ISOTOPE DISPLACEMENT CONSTANT OF MERCURY. Otto Loebich and Andreas Steudel (Universität, Heidelberg). Z. Physik, 166: 56-61(1962). (In German)

The hyperfine structure of the Hg II line λ 2815 Å ($5d^{10}6s\,^2S_{1/2} - 5d^9 6s^2\,^2D_{5/2}$), forbidden for electric dipole radiation, was investigated using a Fabry-Perot interferometer coated with dielectric λ/4 layers (PbF_2 and cryolite). From the measured isotope shift in this line and from recent isotope shift measurements in other Hg II lines the experimental isotope shift constants βC_{exp} for the different isotope pairs were determined to be: (196 – 198): 174 ± 40; (198 – 200): 212 ± 30; (199 – 201): 254 ± 42;

(200 – 202): 235 ± 30; and (202 – 204): 235 ± 37 [$\cdot 10^{-3}$ cm^{-1}]. (auth)

16879 THERMAL EXPANSION OF H_2O AND D_2O SINGLE CRYSTALS. Gerhard Dantl (Technische Hochschule, Stuttgart). Z. Physik, 166: 115-18(1962). (In German)

The linear thermal expansion coefficients of ice and heavy ice single crystals were measured in both hexagonal crystallographic axes between the melting point and 18°K. The expansion coefficients of H_2O and D_2O become negative below 63°K. (auth)

16880 INTERACTION BETWEEN MEDIUM ENERGY (10–100 kev) ATOMIC PARTICLES AND SOLID BODIES (ENERGY SPECTRA OF SECONDARY IONS). B. V. Panin. Zhur. Eksptl'. i Teoret. Fiz., 42: 313-24(Feb. 1962). (In Russian)

The energy spectra of secondary ions emitted from molybdenum and beryllium targets under the bombardment by H_1^+, H_2^+, He^+, O_1^+, O_2^+, N_1^+, N_2^+, CO^+, Ar^+, and Ar^{2+} ions with energies between 7.5 and 80 kev are obtained. Some details of the spectra structure are calculated. It is confirmed that the laws of classical mechanics can be used to describe the mechanism of the phenomenon. (auth)

16881 ON THE INTERACTION OF SLOW POSITIVE RUBIDIUM AND CESIUM IONS WITH A MOLYBDENUM SURFACE. V. I. Veksler (Tashkent State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 325-9(Feb. 1962). (In Russian)

Secondary ion emission from molybdenum bombarded by Cs^+ and Rb^+ ions with energies U = 10 to 250 ev is investigated. The following is shown: (1) primary ion scattering cannot be treated in the elastic sphere pair collision theory; (2) for $U < 40$ ev the effect of binding of atoms in the lattice is so strong that the role of the bombarding ion mass becomes unimportant; (3) appreciable penetration of the ions into the lattice begins for $U > 80$ ev; (4) the assumption of interaction of the bombarding ion with the lattice as a whole agrees much better with the results obtained than the assumption that the effective scattering cross section varies with the energy U; (5) in the presence of an absorbed film on the surface of the bombarded sample, most of the secondary products consists of sputtered absorbed atoms. (auth)

16882 EFFECT OF HELICAL MAGNETIC STRUCTURE ON THE MAGNETOSTRICTION OF DYSPROSIUM. K. P. Belov, S. A. Nikitin (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 403-7(Feb. 1962). (In Russian)

A very complex dependence of magnetostriction on the field strength and temperature has been found in dysprosium in the temperature range from 120 to 190°K. The involved dependence is due to the fact that in the indicated temperature range besides magnetostriction corresponding to rotation of the magnetic moments of the laminae in the basis plane, there also exists a magnetostriction concomitant with destruction of the helicoidal magnetic structure (for $H = H_{кр}$). Moreover, in the neighborhood of the Curie point Θ_2 a large paraprocess magnetostriction arises which is caused by exchange forces between atoms located in neighboring basis planes. (auth)

16883 ON APPLICABILITY OF THE LAW OF SIMILARITY TO IGNITION OF A GAS DISCHARGE IN HYDROGEN. A. S. Pokrovskaya-Soboleva and B. N. Klyarfeld. Zhur. Eksptl'. i Teoret. Fiz., 42: 427-9(Feb. 1962). (In Russian)

Some new experimental data and considerations are presented which point to a deviation from the similarity law for a discharge in hydrogen. (auth)

16884 EXPERIMENTAL INVESTIGATION OF μ^--MESIC ATOM PROCESSES IN GASEOUS HYDROGEN. V. P. Dzhelepov, P. F. Ermolov, E. A. Kushnirenko, V. I. Moskalev, and S. S. Gershtein (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 439-49 (Feb. 1962). (In Russian)

A diffusion cloud chamber in a magnetic field was employed to study a number of μ-mesic atom processes in hydrogen. The following quantitative data have been obtained: cross section for elastic scattering of pμ mesic atoms on protons, $\sigma_{pp} = (1.7^{+0.4}_{-0.3}) \times 10^{-19}$ cm^2; the rates of the μ-meson transfer from a proton to deuterons and complex nuclei (C and O) recalculated for density of liquid hydrogen, $\lambda_d = (0.95^{+0.34}_{-0.21}) \times 10^{10}$ sec^{-1} and $\lambda_Z = (1.2^{+0.8}_{-0.5}) \times 10^{10}$ sec^{-1}; the rate of the formation of ppμ mesic molecules in liquid hydrogen, $\lambda_{pp\mu} = (0.6^{+0.6}_{-0.3}) \times 10^6$ sec^{-1}. The experimental values of λ_d, $\lambda_{pp\mu}$, and λ_Z satisfactorily agree with the theoretical values. This confirms the correctness of the mechanisms of the processes proposed in the theory. The cross section σ_{pp} was found to be close to the theoretical value computed without taking into account the hyperfine structure of the pμ mesic atom. However, it is not excluded that fast transitions to the lower state with a total mesic atom spin F = 0 may occur. The absolute value of λ_d determined opens the possibility of finding the absolute probabilities of a large number of μ mesic molecular processes by employing it as a scale. (auth)

16885 MACROSCOPIC RENORMALIZATION OF THE MASS AND ENERGY LOSSES OF CHARGED PARTICLES IN A MEDIUM. V. N. Tsytovich (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 42: 457-66(Feb. 1962). (In Russian)

The quantum expression for macroscopic renormalization of the mass and energy losses of charged particles in absorbing media with space dispersion is derived by applying the Green's function technique. The effect of space dispersion of the dielectric susceptibility on the magnitude of the macroscopic mass renormalization is considered in the classical limit and the first quantum corrections are found. Quantum corrections to the characteristic collective losses of electrons in thin films are considered. (auth)

16886 THEORY OF RESONANCE SCATTERING ON ATOMIC SYSTEMS. I. DEDUCTION OF GENERAL FORMULAS. M. V. Kazarnovskii and A. V. Stepanov (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 42: 489-98(Feb. 1962). (In Russian)

The probability for resonance scattering is expressed in terms of the correlation function of the scattering system particle coordinates in a way similar to that the scattering probability in the Born approximation can be expressed in terms of the Van Hove pair correlation function. The scattering probability due to interference of resonance and potential scattering is considered in a similar manner. (auth)

16887 THEORY OF NUCLEAR RESONANCE IN PARAMAGNETIC MEDIA. II. SPIN-LATTICE RELAXATION. K. A. Valiev and R. Kh. Timerov (Kazan Pedagogical Inst.). Zhur. Eksptl'. i Teoret. Fiz., 42: 597-9(Feb. 1962). (In Russian)

The longitudinal relaxation rate of nuclear magnetization in paramagnetic media is calculated in the two limiting cases of fast and slow thermal motion in the medium. It is assumed that interaction between the nuclear and electron spins in the system is due to dipole–dipole and contact forces. Precession, relaxation, and exchange motions in the electron spin system are taken into account. (auth)

16888 ON TRANSITION OF LIQUID He^3 TO THE SUPERFLUID STATE. L. P. Gor'kov and L. P. Pitaevskii (Inst. of Problems in Physics, Academy of Sciences, USSR). Zhur. Ekspt'. i Teoret. Fiz., 42: 600-5(Feb. 1962). (In Russian)

The Cooper effect is investigated in liquid He^3 and it is shown that at sufficiently low temperatures He^3 goes over to the superfluid state. The problem of estimating the transition temperature is discussed. Various estimations yield transition temperatures between 2×10^{-4} and 8×10^{-3}°K. (auth)

16889 OBSERVATION OF THE MÖSSBAUER EFFECT IN A TIN-BEARING POLYMER. V. A. Bryukhanov, V. I. Gol'danskii, N. N. Delyagin, E. F. Makarov, and V. S. Shpinel (Inst. of Chemical Physics, Academy of Sciences, USSR and Moscow State Univ.). Zhur. Ekspt'. i Teoret. Fiz., 42: 637-9(Feb. 1962). (In Russian)

The Mössbauer effect was sought in a polymer with a specific weight of 1.2 g/cm^3, and a molecular weight of 2×10^5; the element tin made up 30% of the polymer by weight. A sample of SnO_2 containing the isomer of Sn^{119} served as the source of gamma rays. Resonance absorption spectra were obtained at three temperatures: 77, 195, and 300°K. Two lines of equal intensity were observed. These lines corresponded to velocities of 0 and 3.0 mm/sec and had line widths of 0.8 mm/sec. The spectra can be accounted for by the quadrupole interaction of the Sn^{119} nucleus in an excited state with the nonuniform electric field to be found at the positions where the tin nuclei are situated in the polymer. The probability for absorption of the gamma quantum without release was found to be 0.04 at 77°K and 0.017 at 195°K. (TTT)

16890 THE DYNAMIC BEHAVIOR OF THERMOELECTRIC DEVICES. Paul E. Gray. Technology Press Research Monographs. [Cambridge, Mass.], The Massachusetts Institute of Technology and New York and London, John Wiley & Sons, Inc., 1960. 144p.

The dynamic behavior of thermoelectric heat pumps and generators is discussed. Linear models were developed to describe the small-signal dynamic behavior of the devices. Relations that exist among the incremental components of the variables that define the state of the system were obtained from the frequency-domain solution of a set of linear partial differential equations that were subject to linear boundary conditions and expressed in the form of frequency-domain transfer function. Small-signal analyses for the heat pump and thermoelectric generator, measurements of the small-signal response of a heat pump, and a heat-pump analysis modified to include a temperature-dependent resistivity are given. (M.C.G.)

16891 ENERGY SOURCE DEVICE. Joseph Silverman (to Associated Nucleonics, Inc.). U. S. Patent 3,031,519. Apr. 24, 1962.

A small and easily manufactured device is described for converting nuclear energy to light and thence to electric energy. The device comprises a beta-emitting source and a phosphor confined within a sealed receptacle in such a way that light emitted by the phosphor can be directed on a photovoltaic cell mounted on the outside of the receptacle. (D.L.C.)

16892 RADIATION SENSITIVE GLASS CONTAINING TRIVALENT CERIUM. Robert J. Ginther (to U. S. Navy). U. S. Patent 3,032,428. May 1, 1962.

A radiation-sensitive glass for scintillation response to gammas and neutrons and having many advantages over crystals and organic plastics may be prepared by incorporating trivalent cerium in certain alkali aluminoborate and alkali aluminosilicoborate glasses. The boron makes the glass a neutron detector. The effects of the glass composition on the pulse height of the scintillation response are discussed. The preferred relative glass composition is 1 mole $Na_2O + Li_2O$, 0.25 to 2 moles Al_2O_3, 2.5 to 4 moles $B_2O_3 + SiO_2$, and 0.1 to 0.3 moles Ce_2O_3. (D.L.C.)

16893 COMPOSITE SCINTILLATION CRYSTAL. Wilber L. Meier and Don A. Harvey (to National Radiac, Inc.). U. S. Patent 3,032,657. May 1, 1962.

A composite scintillation crystal for determining the direction of penetrating radiation comprises a crystal holder with a plurality of containers filled with rods of transparent scintillation material. For detection of high-speed particles in two dimensions, the rods are all in parallel; for detection in three dimensions, the rods are arranged in alternating layers of parallel rods. (D.L.C.)

16894 SCINTILLATOR. James F. Bacon, Thomas H. Elmer, and Harrison P. Hood (to Corning Glass Works). U. S. Patent 3,032,659. May 1, 1962.

An improved scintillator comprises a silica base glass with incorporated cerium oxide. The scintillator may be made either by conventional melting practice or by impregnation of a leached, porous glass body. The cerium content can range up to 2 wt %, with the optimum being 0.3 wt %, and the cerium should be in an intermediate state of reduction for best results. (D.L.C.)

Astrophysics and Cosmology

Refer also to abstract 16040.

16895 THE EFFECT OF OPTICAL DEPTH IN THE SPECTRUM OF HELIUM (TRIPLETS) IN NEBULAE. Stuart R. Pottasch (Princeton Univ. Observatory and Inst. for Advanced Study, Princeton, N. J.). Astrophys. J., 135: 385-93(Mar. 1962).

Relative intensities of emission lines in the triplet system of neutral He are determined as a function of the optical depth of an atmosphere in λ 3889. The atmosphere considered is one of low density, comparable to nebulae, to minimize the importance of effects due to electron collisions. The range of optical depth considered is limited so that only lines originating from the metastable 2^3S level show effects of optical depth. Thus $\tau(10830) < 10^4$, since above this value the population of the 2^3P level becomes large enough such that the optical depth in lines arising from that level cannot be ignored. A comparison with the He observations of 5 well-known nebulae shows the effects of optical depth in 3 and probably 4 of these nebula. (auth)

16896 ABUNDANCES IN HIGH-VELOCITY A STARS. I. 7 SEXTANTIS. George Wallerstein, Yvonne H. Stone, and John A. Williams (Univ. of California, Berkeley). Astrophys. J., 135: 459-73(Mar. 1962).

Sirius was compared with 7 Sextantis; the ratio of H to the common metals is about the same in both stars, but the ratio of He to H in 7 Sextantis is about 10 and carbon is overabundant by a factor of 20. Possibly, the star is a very rapid rotator seen pole-on. This could result in a spectrum that is composite of types B8 and A1. Or, if the star has an atmosphere that is describable by a single effective temperature, the abundance anomalies are real. In that case, 7 Sextantis was once a metal-poor main-sequence star which has evolved to the horizontal branch. During its evolution, mass loss and possibly mixing brought the He and C produced in the interior to the surface. The high-velocity A star, HD 161817, is compared with Sirius and a rough comparison of Sirius with the sun is made. Sirius is overabundant in Fe by a factor of 5 and in Ti, by 2. (auth)

16897 VELOCITY FIELDS IN THE SOLAR ATMOSPHERE. I. PRELIMINARY REPORT. Robert B. Leighton, Robert W. Noyes, and George W. Simon (California Inst. of Tech., Pasadena). Astrophys. J., 135: 474-99(Mar. 1962).

Velocity fields in the solar atmosphere were detected and measured by an adaptation of a technique for measuring magnetic fields (R. B. Leighton. Ap. J. 130: 366 (1959)). Data obtained during the summers of 1960 and 1961 were partially analyzed, and principal results are described. (L.N.N.)

16898 DEPARTURES FROM THERMODYNAMIC EQUILIBRIUM IN CHROMOSPHERIC Mg I, Ca I, AND O I. R. Grant Athay and Lewis L. House (High Altitude Observatory, Boulder, Colo.). Astrophys. J., 135: 500-14(Mar. 1962).

Comparisons of intensities of Mg I and O I emission lines in the flash-spectrum of the low chromosphere reveal evidence of marked departures from a Boltzmann distribution of populations of energy levels. These departures are in the same sense as those found earlier for He I, viz., an overpopulation of the levels connected to the ground state through optically forbidden transitions relative to the levels with permitted transitions. A search for a similar effect in the populations of the excited singlets and triplets of Ca I did not indicate a significant departure from a Boltzmann distribution for the levels studied. Evidence is found that the ratio Ca I/Ca II is much greater than would be expected in thermodynamic equilibrium. For Mg I, the optical thickness of the chromosphere in the triplet lines is obtained directly from the observed intensity of the forbidden intercombination line λ 4571 (3^3P-3^1S). Computed populations of energy levels for a model Mg I atom under a range of temperature and density show agreement with observational data for choices of chromospheric temperatures and densities consistent with a model departing from spherical symmetry. (auth)

16899 THE EFFECT OF A VERTICAL MAGNETIC FIELD ON THE PROPAGATION OF GRAVITY WAVES ALONG THE PLANE OF A SEMI-INFINITE VISCOUS, ELECTRICALLY CONDUCTING FLUID. P. H. Roberts and A. D. Boardman (Univ. of Chicago and Univ. of Sheffield. Eng.). Astrophys. J., 135: 552-92(Mar. 1962).

Basic equations and boundary conditions governing effects of vertical magnetic and gravitational fields on small-amplitude perturbations of the free equilibrium surface of a viscous, electrically conducting fluid are presented. Normal modes are examined. A dispersion relationship is derived which relates the complex "frequency" n of the normal mode to the Alfvén velocity, V; the viscosity, ν; the magnetic diffusivity, λ; and the horizontal wave number, k. This dispersion relationship is solved in nine extreme cases. In six of these, the magnetic field is too weak to modify substantially the familiar gravity-wave solution holding in the absence of a magnetic field. The influence of the field is so strong in the remaining three cases that they have no parallel in the zero-field case. One of these holds for any k if the magnetic field is sufficiently strong. In this case $n = -gV^{-1}(\lambda/\nu)^{1/2}$; i.e., the effect of the magnetic field is so great that the disturbance is attenuated aperiodically as the Alfvén waves radiate energy away from the free surface. Another interesting feature demonstrated is the existence (if V is sufficiently large) of a band of wave numbers k for which no normal-mode solution exists. It is nevertheless demonstrated that the associated initial-value problem can be solved for such values of k. In addition to the nine extreme cases mentioned above, three special cases are solved for all k for particular values of V, namely, $\nu = \lambda$, $\nu = 0$, and $\lambda = 0$. (auth)

16900 HYDROMAGNETIC OSCILLATIONS OF A SELF-GRAVITATING FLUID. Donat G. Wentzel (Univ. of Michigan, Ann Arbor). Astrophys. J., 135: 593-8(Mar. 1962).

Hydromagnetic modes of oscillation of a self-gravitating fluid are investigated using the tensor virial theorem. For a spherically symmetric density distribution and an axisymmetric magnetic field, the equations yield the radial homologous pulsation and the Kelvin oscillation, with the periods modified by the magnetic field. The effect on these oscillations of an axisymmetric distortion of the configuration of equilibrium is evaluated. In the case of resonance between the two modes, the poles and the equator oscillate independently of each other and with slightly different periods. There are also four modes of oscillation which do not preserve axisymmetry. (auth)

16901 THE TIME OF FORMATION OF THE SOLAR SYSTEM RELATIVE TO NUCLEOSYNTHESIS. V. Rama Murthy and Harold C. Urey (Univ. of California, San Diego and La Jolla). Astrophys. J., 135: 626-31(Mar. 1962).

The chronology of events in the early history of the solar system determined by extinct radioactive-decay intervals results in an unreasonable time scale, if the commonly used "sudden synthesis" or "continuous synthesis" models of element formation are employed. An alternative model, in which additions of short-lived radioactivities were made to the material of the solar system by a supernova, is suggested, based on recent astronomical observations on expanding stellar associations in the Galaxy. Estimates for the end of melting processes in this model range from 9 to 15 million years; the calculated cooling times range from 156 to 190 million years. If Al^{26} were the effective heat source for melting processes, solid bodies must have formed in the solar system during the first 2 million years after the supernova explosion. If the moon is a primary object and was formed at low temperatures, such objects must have formed about 6 million years after this event. (auth)

16902 ATTI DEL IV SYMPOSIUM SULLA DINAMICA DEL GAS COSMICO, VARENNA SUL LAGO DI COMO 18-30 AGOSTO 1960. (Proceedings of the Fourth Symposium on Conference on Dynamics of Cosmic Gases, Varenna [Italy] (Lake of Como), August 18-30, 1960). Nuovo cimento (10), 22: Suppl. No. 1, 531p.(1961).

Fifteen papers are included: separate abstracts have been prepared for 10. A single abstract has been prepared to cover the remaining 5 papers, which consist of observational studies. Extensive discussions are included. (T.F.H.)

16903 QUESTIONS OF GENERAL BACKGROUND AND METHODOLOGY RELATING TO AERODYNAMIC PHENOMENA IN STELLAR ATMOSPHERES. J.-C. Pecker (Observatorie de Meudon [France]) and R. N. Thomas. Nuovo cimento (10), 22: Suppl. No. 1, 1-68(1961). (In English)

The aerodynamics (i.e., the study of velocity fields, thermodynamic fields, and their interactions) of stellar atmospheres is studied. Particular attention is devoted to the analysis of spectra in order to infer line-of-sight motion, and to a review of the general astronomical methodology. (T.F.H.)

16904 GENERAL SUMMARY OF RESULTS ON "ASTRONOMICAL TURBULENCE" IN STELLAR ATMOS-

PHERES. A. B. Underhill (Dominion Astrophysical Observatory, [Lower Hutt, N. Z.]). Nuovo dimento (10), 22: Suppl. No. 1, 69-130(1961). (In English)

Attention is given to stars that do not change radically with time (thus excluding explosive and periodic variable stars). For these stars, the atmospheric velocity fields and their time dependence are studied. The effects of macroscopic and microscopic turbulences on the stellar spectra are investigated. The gross movement of stellar matter is discussed. (T.F.H.)

16905 SPHERICALLY-SYMMETRIC MOTIONS IN STELLAR ATMOSPHERES. A. PULSATING VARIABLE STARS. SUMMARY-INTRODUCTION: VELOCITY FIELDS AND ASSOCIATED THERMODYNAMIC VARIATIONS IN THE EXTERNAL LAYERS OF INTRINSIC VARIABLE STARS. P. Ledoux and C. A. Whitney (Université, Liège and Smithsonian Astrophysical Observaroty, [Cambridge, Mass.]). Nuovo cimento (10), 22: Suppl. No. 1, 131-208 (1961). (In English)

Velocity and thermodynamic oscillations in the external layers of intrinsic variable stars of the cepheid and *RR Lyrae* types are reviewed. The characteristics of linear radial oscillations of such stars are investigated. The effects of oscillations on the atmospheric properties, the types of waves set up in the atmosphere by the oscillations, and the dynamic theory governing the behavior of the atmosphere are surveyed. An annotated bibliography is presented consisting of 16 references to material on velocity fields in pulsating atmospheres. (T.F.H.)

16906 SPHERICALLY-SYMMETRIC MOTIONS IN STELLAR ATMOSPHERES. B PROPAGATION OF A SHOCK-WAVE IN AN ATMOSPHERE OF VARYING DENSITY. E. Schatzman (Institut d'Astrophysique, Paris). Nuovo cimento (10), 22: Suppl. No. 1, 209-37(1961). (In English)

A survey is presented of the applications of the physical theory of shock waves to the study of stellar phenomena. Shock waves in variable-density media are concluded to be responsible for novae, supernovae, some properties of cepheids, and some properties of stellar chromospheres and coronae. (T.F.H.)

16907 SPHERICALLY-SYMMETRIC MOTIONS IN STELLAR ATMOSPHERES. C. NON-CATASTROPHIC MASS-LOSS FROM STARS. A. Deutsch (Mt. Wilson and Palomar Observatories, Pasadena, Calif.). Nuovo cimento (10), 22: Suppl. No. 1, 238-95(1961). (In English)

The loss of mass by stars by means of more or less steady-state outflows of stellar gases into the interstellar space is studied. The relatively slow and cold outflow from late-type giants and supergiants is given primary attention. Observational evidence for this type of outflow is reviewed, and the thermodynamic variables and their gradients within the outflows from two particular stars are given as examples. The observations are compared with the theory of stationary, spherically symmetric, laminar gas flows under the influence of gravity alone. (T.F.H.)

16908 REMARKS ON STEADY PERFECT FLUID FLOW WITH SPHERICAL SYMMETRY. P. Germain (Institut Henri Poincaré, Paris). Nuovo cimento (10), 22: Suppl. No. 1, 296-312(1961). (In English)

The steady outflow of a perfect gas from a star is calculated by fitting the equations of continuity of mass, momentum, and energy to the boundary conditions of the observed temperature and specific volume in interstellar space. The uniqueness and form of the solutions obtained are discussed. The existence of shock waves is considered. (T.F.H.)

16909 CONSIDERATIONS ON LOCALIZED VELOCITY FIELDS IN STELLAR ATMOSPHERES: PROTOTYPE—THE SOLAR ATMOSPHERE. A. CONVECTION AND GRANULATION: PREVIEW ON GRANULATION—OBSERVATIONAL STUDIES. Nuovo cimento (10), 22: Suppl. No. 1, 313-75(1961). (In English)

Photographs and motion pictures of the solar surface taken from sea level and from balloon heights, respectively, are described. Photographic techniques for analyzing the solar photosphere and its granulations are outlined. Photographic evidence for the presence of horizontal and vertical velocity fields in the photosphere is presented. The motion and magnetic fields in the undisturbed photosphere, and in the chromosphere outside the active regions, are examined. The theory governing the convectively unstable zone, which exists several hundred km below the stellar surface, and which gives rise to the granulation effect, is investigated. (T.F.H.)

16910 CONSIDERATIONS ON LOCALIZED VELOCITY FIELDS IN STELLAR ATMOSPHERES: PROTOTYPE—THE SOLAR ATMOSPHERE. B. CONSIDERATION OF CONVECTIVE INSTABILITY FROM THE VIEWPOINT OF PHYSICS. SUMMARY-INTRODUCTION: SIMILARITY ARGUMENTS FOR FULLY DEVELOPED TURBULENCE. W. V. R. Malkus (Woods Hole Oceanographic Institution, Mass.). Nuovo cimento (10), 22: Suppl. No. 1, 376-402 (1961). (In English)

Two types of steady-state turbulent flow are considered: shearing flow of an incompressible fluid between two parallel planes; and convection between horizontal parallel planes at different temperatures. Similarity arguments are advanced, based on the assertions that the mean profiles of temperature and velocity approach, but never exceed, the local condition for marginal inviscid instability and that the smallest scale of motion effective in the transport of heat, or momentum, is a monotonically increasing function of the Rayleigh, or Reynolds, number of the flow. The consequences of these similarity arguments regarding the heat and momentum transports in the flows are discussed. (T.F.H.)

16911 CONSIDERATIONS ON LOCALIZED VELOCITY FIELDS IN STELLAR ATMOSPHERES: PROTOTYPE—THE SOLAR ATMOSPHERE. C. TRANSIENT VELOCITY FIELDS IN THE LOWER SOLAR ATMOSPHERE. A. B. Severnyi (Severny) (Crimean Astrophysical Observatory, USSR). Nuovo cimento (10), 22: Suppl. No. 1, 403-47 (1961). (In English)

The velocity and magnetic fields are investigated in and near sunspots, flares, flocculi and faculae, and prominences on the solar surface. (T.F.H.)

16912 CONSIDERATIONS ON LOCALIZED VELOCITY FIELDS IN STELLAR ATMOSPHERES: PROTOTYPE—THE SOLAR ATMOSPHERE. D. COLLISION-FREE SHOCK-WAVES. SUMMARY-INTRODUCTION: COLLISION-FREE PLASMAS. H. E. Petschek (Avco-Everett Research Lab., Everett, Mass.). Nuovo cimento (10), 22: Suppl. No. 1, 448-58(1961). (In English)

In the corona region of stars the ratio of the mean free path for interparticle collisions to the particle gyroradius becomes quite large. Under this condition the transport processes in the plasma become dominated by plasma turbulence. This phenomenon can be described in terms of the kinetic theory of a random distribution of waves. The structure of a shock wave under these conditions is considered. The effects of such a turbulent wave field on the electrical conductivity of the medium are considered. The shock-wave thickness is calculated as a function of particle density. (T.F.H.)

16913 CONSIDERATIONS ON LOCALIZED VELOCITY FIELDS IN STELLAR ATMOSPHERES: PROTOTYPE—THE SOLAR ATMOSPHERE. D. COLLISION-FREE SHOCK-WAVES. SECOND SUMMARY-INTRODUCTION: STEADY ONE-DIMENSIONAL FLUID-MAGNETIC COLLISIONLESS SHOCK THEORY. A. A. Blank and H. Grad (New York Univ., New York). Nuovo cimento (10), 22: Suppl. No. 1, 459-67(1961). (In English)

Shock waves in collisionless plasmas are studied by means of steady-state one-dimensional theories. A mechanism is proposed to provide the irreversible nature required of such a shock wave. One-fluid and two-fluid theories are outlined, and their solutions at zero temperature and finite temperatures are discussed. The validity of these theories in the weak-shock region is discussed. (T.F.H.)

16914 ON THE ORIGIN OF PLANETARY NEBULAE. Shirô Sakashita and Yasuo Tanaka (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 27: 127-32(Jan. 1962). (In English)

A hypothesis that planetary nebulae originate from red giants when the helium burning begins in the degenerate helium core is proposed and examined quantitatively. It is assumed that the shock wave is generated by the rapid core expansion which is caused by the removal of degeneracy at the helium core. The propagation of the shock wave is analyzed by the quasi-stationary method. The obtained expansion velocity and thrown mass are 95 km/sec and 0.5 M⊙, respectively. A relation between remnant stars and nuclei of planetary nebulae is discussed. (auth)

16915 EVOLUTION OF POPULATION II STARS IN THE HELIUM-BURNING PHASE. Minoru Nishida and Daiichiro Sugimoto (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 27: 145-54(Jan. 1962). (In English)

Evolution of 1.2 M⊙ Population II stars in the helium-burning phase is investigated, taking into account the effect of conversion of helium into carbon and oxygen on the mean molecular weight and on the nuclear energy generation. The stellar models consist of a hydrogen-rich envelope, a radiative pure helium zone, and a convective core in which helium burning occurs. The mass fraction of helium region is fixed respectively at 0.45, 0.50, and 0.54 and is treated as a parameter. Series of models are constructed for various helium contents in the convective core. The stars stay nearly in the narrow region of the horizontal branch of H-R diagram of the globular cluster M3, but the dependence of stellar radii on the nuclear reaction rates are so strong that a change by one order of magnitude of the rate for CN-cycle shifts the stars through the horizontal branch. The calculated lifetime for this phase is 3×10^7 years. (auth)

16916 RADIO WAVE ABSORPTION IN THE IONOSPHERE. N. C. Gerson, ed. Oxford, London, New York, and Paris, Pergamon Press, 1962. 389p. (AGARDograph 53) £5 5s.

The theory and measurement of radio wave absorption in the ionosphere are surveyed. The Luxembourg effect, latitude effects, polar-cap absorption effects, D and E region effects, and absorption anomalies are reviewed. The properties of the ionosphere are investigated. (T.F.H.)

Cosmic Radiation

Refer also to abstracts 16038, 16039, and 16186.

16917 THE COSMIC RAY STORM OF JULY, 1961. S. P. Duggal and M. A. Pomerantz (Bartol Research Foundation, Swarthmore, Penna.). J. Franklin Inst., 273: 322-9(Apr. 1962).

Observations of sudden cosmic-ray increases up to 8 million km from the earth were made using a space probe and satellite. Measurements were made in July, 1961. Intensity peaks arose from a directional anisotropy, possibly caused by turbulent magnetic fields in the solar plasma which produced the Forbush decrease. Although a geocentric mechanism involving an interaction between the geomagnetic field and the magnetized cloud producing the basic modulation is not precluded as an explanation of temporary increases, a change-in-cutoff model seems untenable for describing the fine structure in the cosmic storm. Effects observed could be ascribed to holes in the modulating region or to local acceleration effects. (L.N.N.)

16918 HEAVY PRIMARY COSMIC RAYS OVER JAPAN. H. Hasegawa (Rikkyo (St. Paul's) Univ., Tokyo). Nuovo cimento (10), 23: 292-306(Jan. 16, 1962). (In English)

Heavy nuclei ($Z \geq 10$) of primary cosmic rays over Japan in 1956 and 1957 were investigated. Charge distribution at balloon altitudes does not show remarkable difference from that of other investigators. The even-odd ratio in numbers of H′-nuclei ($10 \leq Z \leq 19$) at balloon altitude is 2.13 ± 0.71, and is extrapolated to the top of the atmosphere. The flux values in both years are: $J^0_{VH} = 0.08 \pm 0.05$, $J^0_{H'} = 0.46 \pm 0.11$, $J^0_H = 0.54 \pm 0.12$ (particles $m^{-2}\ s^{-1}\ sr^{-1}$) for 1956, and $J^0_{VH} = 0.14 \pm 0.04$, $J^0_{H'} = 0.26 \pm 0.04$, $J^0_H = 0.40 \pm 0.06$ (particles $m^{-2}\ s^{-1}\ sr^{-1}$) for 1957. The values of 1957 correspond to the minimum values of cosmic fluxes during the period of eleven year solar activity. And $J^0_{VH}/J^0_{H'} = 0.41 \pm 0.11$ was obtained. A new method to determine the charges of particles in nuclear emulsion is described. The integral blob length distribution is shown to be exponential, and the coefficient, g′, of the exponent is used as a measure of the ionization. (auth)

16919 THE MOMENTUM SPECTRUM OF μ-MESONS AT 37 m WATER EQUIVALENT UNDERGROUND. J. E. Cousins and W. F. Nash (Univ. of Nottingham, Eng.). Nuovo cimento (10), 23: 307-22(Jan. 16, 1962). (In English)

A direct measurement of the momentum spectrum of μ mesons with momenta greater than 1 Bev/c was made under Castle Rock, Nottingham, at a depth of 37.24 m w.e. The spectrograph consisted basically of two 28 cm diameter cloud chambers; one above and one below the air gap of a large permanent magnet. The measured spectrum contains 1481 particles. The results were analyzed by comparing the experimental spectrum with spectra derived from the sea-level momentum spectrum measured by the Manchester group, assuming various values of the energy loss of the fast particles in the rock. The experiment shows that the most probable value of the energy loss in the rock is 7.5 Bev for μ mesons arriving underground with momenta in the range 1 to 20 Bev/c. These results are in satisfactory agreement with calculations and illustrate the density correction in collision loss calculations. (auth)

16920 A STUDY ON THE EXTENSIVE AIR SHOWERS. Naofumi Ogita (Kinki Univ., Osaka). Progr. Theoret. Phys. (Kyoto), 27: 105-26(Jan. 1962). (In English)

Using totally-inelastic and half-elastic collision models, quantities in extensive air showers (EAS) are given as functions of the depth from the starting point of EAS. The effect of the fluctuation in the level of shower initiation is illustrated. The calculated results are compared with the experimental ones, taking into account the above fluctuation; the value of the average inelasticity is estimated. The consistency between the attenuation length obtained by using the correlation diagrams in some quantities and that of the shower intensity is examined in connection with the form of the energy spectrum of the primary particles. (auth)

16921 POLARIZATION OF HIGH ENERGY COSMIC RAY μ-MESONS. V. S. Berezinskii (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 42: 485-8(Feb. 1962). (In Russian)

The problem of polarization of high-energy (2×10^9 to 10^{13} ev) cosmic ray μ mesons is solved. The solution is derived by employing a new solution of the diffusion equation for μ mesons and by assuming that all μ mesons are produced in the decay of π mesons. The dependence of the polarization on energy is obtained. (auth)

Elementary Particles and Radiations

16922 (AD-261903) ANTIPROTON INTERACTION CROSS SECTIONS. A. G. Ekspong and B. E. Ronne (Uppsala Univ. Inst. of Physics). [1961]. 32p.

A study was made of 371 antiproton tracks in nuclear emulsions in the energy region 250 to 0 Mev. A path length of 36.5 meters was followed. Ten elastic p-p scattering events together with eleven events published earlier yielded an elastic scattering cross section of 77 ± 17 mb. The total and the differential elastic cross sections were consistent with the theory by Chew and Ball. The mean free path for annihilation in the energy region 35 to 250 Mev was 19.4 ± 1.5 cm, and the inter-action mean free path was 17.4 ± 1.2 cm. An effective antiproton-nucleon cross section of 170, +30−25 mb was deduced from an optical model calculation. Six inelastic scatterings are reported. Together with the 8 or 9 events published by Goldhaber et al., an inelastic scattering cross section of 43 ± 11 mb per emulsion nucleus (hydrogen excluded) was obtained. The low value of the cross section is discussed in the light of the optical model. The elastic scattering on complex nuclei seems to agree with a completely absorbing nucleus. (auth)

16923 (JINR-E-859) ESTIMATIONS OF THE EFFECTIVE RADIUS OF PARTICLE INTERACTION. M. I. Shirokov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 12395.

16924 (NP-11509) THE POLARIZATION OF NEUTRONS FROM THE PHOTODISINTEGRATION OF DEUTERIUM. Technical Report No. 34. David Eugene Frederick (Illinois. Univ., Urbana. Physics Research Lab.). Feb. 1962. Contract ONR 1834(05). 214p.

The polarization of neutrons photoproduced from deuterium at about 148° in the center of mass system was measured at four intervals in the photon energy range of 11.0 to 22.9 Mev in the laboratory system. The neutron polarization was analyzed in a low pressure helium diffusion cloud chamber by scattering the neutrons and observing the left-right asymmetry in the helium gas nuclear recoils. This was achieved by photographing the individual recoils on film, then making measurements on the stereoscopically projected recoil track images, and finally subjecting the data to a maximum likelihood calculation. The photography of the random scattering events was accomplished by illuminating the chamber with a slide projector light beam and then detecting the light reflected by the vapor condensation on the recoil paths. The polarizations measured in the four photon energy intervals of 11.0 to 12.9 Mev, 13.0 to 15.9 Mev, 16.0 to 17.9 Mev, and 18.0 to 22.9 Mev are −0.032 ± 0.078, −0.198 ± 0.086, −0.254 ± 0.120, and −0.296 ± 0.137, respectively. The polarization is defined to be positive in the direction of $\vec{k}_\gamma \times \vec{k}_{ne}$, the directions of the incoming photon and outgoing photoneutron, respectively. The results are substantially in agreement with the polarization calculations by deSwart and Marshak and by Rustgi, Zernik, Breit, and Andrews. (auth)

16925 (NP-11592(Vol.I)) THE AIX-EN-PROVENCE INTERNATIONAL CONFERENCE ON ELEMENTARY PARTICLES, SEPTEMBER 14-20, 1961. VOLUME I. PARALLEL SESSIONS. E. Cremieu-Alcan, P. Falk-Vairant, and O. Lebey, eds. (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 511p.

A total of seventy-six papers is included, thirteen of which are presented in French. Nine papers on subjects in the area of elementary particle interactions were previously abstracted in Nuclear Science Abstracts. Separate abstracts were prepared for each of the remaining 67 papers. (J.R.D.)

16926 (NP-11592(Vol.I)(p.9-15)) THE SINGLE PHOTOPRODUCTION OF NEUTRAL PIONS IN HYDROGEN IN THE ENERGY RANGE 600 TO 800 Mev. USE OF THE SPARK CHAMBER TECHNIQUE. M. Deutsch, C. Mencuccini, R. Querzoli, G. Salvini, G. V. Silvestrini, and R. Stiening (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

Results are presented which were obtained as part of a program mainly devoted to a study of the shape and the absolute value of the cross section for photoproduction of neutral pions around the second resonance. Spark Chamber results are reported on average cross section as a function of energy. (J.R.D.)

16927 (NP-11592(Vol.I)(p.17-20)) THE POLARIZATION OF THE PROTONS FROM THE REACTION $\gamma + p \to \pi^0 + p$ AT 910 Mev. C. Mencuccini, R. Querzoli, and G. Salvini (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

A polarization point for recoil protons at 910 Mev and 90° c.m.s. was measured. Results are presented graphically along with a general graphically represented view of all measurements of recoil protons at 90° c.m. versus γ radiation energy. Quantum numbers for the A, B, and C resonant states for neutral photoproduction at 500 to 1000 Mev are listed. (J.R.D.)

16928 (NP-11592(Vol.I)(p.21-4)) PHOTOPRODUCTION OF SINGLE POSITIVE PIONS IN HYDROGEN AT AND NEAR 0°, FOR $E_\gamma = 600, 700, 800$ Mev. M. Beneventano, G. Finocchiaro, R. Finzi, L. Mezzetti, L. Paoluzi, C. Schaerf, and S. Tazzari (Rome. Università. Istituto di Fisica and Italy. Istituto Nazionale di Fisica Nucleare, Rome).

The measurements were made in an electron synchrotron at angles between 20 and 0° (c.m.). The experimental apparatus is described and results are presented graphically with interpretive remarks. (J.R.D.)

16929 (NP-11592(Vol.I)(p.25-6)) PION PRODUCTION BY POSITIVE PIONS ON PROTONS AT 308 Mev KE. R. Carrara, M. Cresti, A. Grigoletto, A. Loria, L. Peruzzo, R. Santangelo, and D. Venchiarutti (Padua. Università. Instituto di Fisica).

An analysis is presented concerning measurements on pictures taken in conjunction with exposure of the CERN 32-cm hydrogen bubble chamber to a positive pion beam at about 310 Mev from a synchrocyclotron. A sample of 5000 events was studied, and a total inelastic cross section of $0.40^{+0.23}_{-0.18}$ mb at 308 Mev KE found. (J.R.D.)

16930 (NP-11592(Vol.I)(p.27-35)) PION PRODUCTION BY POSITIVE PIONS AT 820 AND 900 Mev. R. Barloutaud, C. Choquet, C. Gensollen, J. Heughebaert, A. Leveque, J. Meyer, and G. Viale ([France. Commissariat à l'Energie Atomique. Centre d'Études Nucléaires, Saclay]).

An analysis of scattering events concerning 800- to 900-Mev incident pions observed in a 35-cm hydrogen bubble chamber is presented. Results indicate but do not confirm the existence of T = 2 pion-pion interaction. (J.R.D.)

16931 (NP-11592(Vol.I)(p.37-43)) PROTON SCATTERING IN THE ENERGY REGION 500–1100 Mev. F. Grard, G. R. Macleod, L. Montanet (European Organization for Nuclear Research, Geneva); M. Cresti (Padua. Universita. Istituto di Fisica); R. Barloutaud, C. Choquet, J. M. Gaillard, J. Heughebaert, A. Leveque, P. Lehmann, J. Meyer, and D. Revel (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay).

Results are presented on π^--p scattering at 516, 616, 710, 887, and 1085 Mev and preliminary results on π^+-p scattering at 820 and 900 Mev are included. A discussion is also included on the angular distributions of elastic scattering and the values for the total elastic and inelastic cross-sections for π^--p, π^+-p, and for the isotopic spin T = ½ state. (J.R.D.)

16932 (NP-11592(Vol.I)(p.45-55)) MESURE DE LA SECTION EFFICACE TOTALE DES PROCESSUS NEUTRES DANS L'INTERACTION π^--p DE 300 A 1600 MeV ET DETERMINATION DU RAPPORT ENTRE LA PRODUCTION DE π^0 ET L ECHANGE DE CHARGE JUSQU'A 1112 Mev. (Measurement of the Total Cross Section for Neutral Processes in the π^--p Interaction from 300 to 1600 Mev and Determination of the Relation Between π^0 Production and Charge Exchange up to 1112 Mev). J. C. Brisson, P. Falk-Vairant, J. P. Merlo, P. Sonderegger, R. Turlay, and G. Valladas (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay).

16933 (NP-11592(Vol.I)(p.57-67)) π-PRODUCTION IN p-p COLLISIONS AT 2.1 AND 2.9 Bev. L. C. L. Yuan (France. Commissariat à l'Energie Atomique. Centre d'Études Nucléaires, Saclay).

A report is presented concerning spectral measurements of the charged π-mesons produced in an H_2 target by an external proton beam at 2.1 and 2.9 Bev. (J.R.D.)

16934 (NP-11592(Vol.I)(p.73-7)) PHOTON PRODUCTION IN PROTON-PROTON COLLISIONS AT 23.1 Gev. M. Fidecaro, G. Finocchiaro, G. Gatti, G. Giacomelli, W. C. Middelkoop, and T. Yamagata (European Organization for Nuclear Research, Geneva).

Photons produced by impinging a 23.1-Bev proton beam on a 20-cm diameter liquid hydrogen target were studied. Results are compared with statistical models and predictions. (J.R.D.)

16935 (NP-11592(Vol.I)(p.79-83)) PRODUCTION OF ELECTRON-PAIRS BY 16 Gev/c PIONS. D. Evans, A. Hossain, F. M. Votruba, et al. (European Organization for Nuclear Research, Geneva).

Several stacks of nuclear emulsions were exposed to high-energy negative pion beams to study events in which the incident pions produce three secondary pions without appreciable momentum transfer to the target nucleus. In the course of the experiment, a number of trident events in which the secondary particles are two electrons and one meson were found. An analysis of these events is presented for comparison with predictions for direct production of electron pairs by pions at 16 Bev. (J.R.D.)

16936 (NP-11592)(Vol.I)(p.85-91)) PROTON-PROTON ELASTIC SCATTERING AT 24 Gev/c AND 19.8 Gev/c. V. A. Bull and D. A. Garbutt (London. Univ. University Coll.).

A stack of Ilford G5 stripped emulsions were exposed to a 24-Bev beam of protons. Data from scanning these emulsions were used to obtain a total elastic cross section of 5.8 ± 0.8 mb. Water-soaked emulsions were similarly exposed to 19.8-Bev protons. An analysis of these results is included. (J.R.D.)

16937 (NP-11592(Vol.I)(p.93-100)) STRANGE PARTICLE PRODUCTION IN HYDROGEN BY 16 Gev/c NEGATIVE PIONS AND 24 Gev/c PROTONS. (Pisa, Italy. Università and Trieste. Università).

A confirmation report is presented concerning earlier data on the production of strange particles in 16-Bev π^--p collisions. The included data are based on 60,000 pictures. Preliminary results are also reported from experiments on 24-Bev p-p collisions. Data on cross sections for strange particle production at these energies are included. (J.R.D.)

16938 (NP-11592(Vol.I)(p.101-10)) V^0 PAIRS PRODUCED IN THE ECOLE POLYTECHNIQUE ONE METER PROPANE BUBBLE CHAMBER BY π^- OF 6,1, 11,6 AND 18,1 Gev/c. M. Di Corato, E. S. Gelsema, A. Minguzzi-Ranzi, et al. (European Organization for Nuclear Research, Geneva).

Results of a study are presented concerning V^0 pairs produced in a propane chamber by mesons (π^-) at 6.1, 11.6, and 18.1 Bev. Results show that the cms regular distribution of the K^0 mesons produced in K^0K^0 pairs have a strong forward peak, while the angular distribution of the K mesons produced in K^0Y^0 pairs is isotropic. (J.R.D.)

16939 (NP-11592(Vol.I)(p.111-15)) ELASTIC SCATTERING OF HIGH ENERGY PROTONS ON HYDROGEN NUCLEI. G. Cvijanovic, P. Egli, W. Koch, M. Nikolic, R. Schneeberger, H. Winzeler (Bern. Universität. Physikalisches Institut); G. Czapek, and G. Kellner (Vienna. Universität. Institut für Theoretische Physik).

Results are presented concerning scattering of 24.5-Bev protons on H nuclei with L-scattering angles above 2 mrad. (J.R.D.)

16940 (NP-11592(Vol.I)(p.117-20)) SUR L'EMISSION DES FRAGMENTS ^{8}Li ET ^{8}B DANS LES INTERACTIONS DE PROTONS DE 24,8 Gev/c AVEC LES ELEMENTS DE L'EMULSION IONOGRAPHIQUE. (On the Emission of Fragments Li^8 and B^8 in the Interactions of 24.8 Gev/c Protons with the Elements of Ionographic Emulsions). H. Braun, G. Baumann, and P. Cuer (Strasbourg. Université. Centre de Recherches Nucléaires).

The angular and energy distributions of Li^8, Li^9, and B^8 nuclei ejected by the reactions of monoenergetic 24.8-Bev/c protons on emulsion nuclei are measured. The data are interpreted in terms of a combination of range-energy relationships and evaporation theory. (T.F.H.)

16941 (NP-11592(Vol.I)(p.121-37)) RECENT RESULTS ON THE FORM FACTORS OF THE NEUTRON AND ON THE STRUCTURE OF NUCLEONS. C. De Vries and R. Hofstadter (Stanford Univ., Calif. High-Energy Physics Lab.); Robert Herman (General Motors Corp. Research Labs., Warren, Mich.), and S. Krasner (Office of Naval Research, Washington, D. C.).

Preliminary results are presented from an analysis using the latest experimental data on the proton's Dirac and Pauli form factors (F_{1P},F_{2P}). These results show detailed and important differences from the older data. The sources of these differences are discussed in detail. Results are presented and discussed. (J.R.D.)

16942 (NP-11592(Vol.I)(p.139-40)) DIFFUSION ELECTRON PROTON A FAIBLES MOMENTS DE TRANSFERT.

(Electron–Proton Scattering with Weak Moments of Transfer). P. Lehmann, R. Taylor, and R. Wilson (Paris. Université, Orsay. Ecole Normale Supérieure, Faculté des Sciences).

The absolute scattering cross section for the e-p interaction is measured at a momentum transfer of 2.98 fermi^{-2} and at angles of 105 and 150°. The data are used to determine the ratio of the charge and magnetic moment form factors of the proton, and to find the values of these form factors. (T.F.H.)

16943 (NP-11592(Vol.I)(p.141)) THE CAPTURE RATE FOR MUONS IN HELIUM. H. L. Anderson, E. P. Hinks, C. S. Johnson, C. Rey, and A. M. Segar (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies).

Measurements are reported on the relative number of capture neutrons and decay electrons observed from muons stopping in liquid He. A capture rate of $1.3 \times 10^3\ \text{sec}^{-1}$ is reported. (J.R.D.)

16944 (NP-11592(Vol.I)(p.143-5)) THE DECAY RATE OF NEGATIVE MUONS BOUND IN K-ORBITS AROUND IRON NUCLEI. G. Culligan, D. Harting, N. H. Lipman, and G. Tibell (European Organization for Nuclear Research, Geneva).

Results obtained in measurements of iron-bound negative muon decay are reported. It is concluded that under the experimental conditions, the measured decay rates agree with theoretical predictions. (J.R.D.)

16945 (NP-11592(Vol.I)(p.147-50)) THE SCATTERING OF 8 Gev/c μ-MESONS ON ELECTRONS. G. Backenstoss, B. D. Hyams, G. Knop, P. C. Marin, and U. Stierlin (European Organization for Nuclear Research, Geneva).

Results are presented from a μ-e scattering experiment in the CERN proton synchrotron. The μ mesons come from the decay of a 50-m length meson (π) beam and the μ mesons of 8.12 Bev are selected by a bending magnet. (J.R.D.)

16946 (NP-11592(Vol.I)(p.151-3)) A MEASUREMENT OF THE TOTAL CROSS-SECTION FOR THE ANNIHILATION IN FLIGHT OF POSITRONS BETWEEN 2 AND 10 Gev. F. Fabiani, M. Fidecaro, G. Finocchiaro, G. Giacomelli, D. Harting, N. H. Lipman, and G. Torelli (European Organization for Nuclear Research, Geneva).

The measurements were made by bending a beam of gamma radiation at an angle of 51 mrad with respect to the internal beam of the CERN proton synchrotron to strike a Cu converter for positron pair production. The beam direction is arranged so that a lead-glass Cherenkov counter gives an output proportional to the total energy of all incident electrons, positrons, or γ-rays. Experimental results are tabulated along with theoretical values. (J.R.D.)

16947 (NP-11592(Vol.I)(p.163-8)) THEORY OF THE STRANGE PARTICLES. H.-P. Durr and W. Heisenberg.

Comments concerning a paper by the authors on the theory of strange particles are presented. Final results of research reported in the paper are reproduced and presented tabularly. It is noted that when final experimental results become available in the future, their comparison with the theoretical results on hyperons will offer a direct check on the underlying group theoretical assumptions. (J.R.D.)

16948 (NP-11592(Vol.I)(p.169-70)) CAYLEY OCTONIONS AND STRONG INTERACTIONS. J. M. Souriau and D. Kastler.

A mathematical analysis is presented which results in a formula for representation of the most symmetric lagrangian for strong interactions. In this formalism, L is invariant by the full special orthogonal group of the seven dimensional $\underline{M}$. L is a possible candidate for the leading part of strong interactions at ultra high energies. (J.R.D.)

16949 (NP-11592(Vol.I)(p.171-81)) ETUDE D'UN MODELE SUSCEPTIBLE DE DONNER UNE REPRESENTATION UNIFIEE DU SYSTEME DES PARTICULES ELEMENTAIRES. (Study of a Model Capable of Giving a Unified Representation of Elementary Particle Systems). Gérard Petiau (Paris. Université. Institut Henri Poincaré).

A nonlinear model is presented that describes the ensemble of physical elementary particles in terms of forms or branches of the general solution of a system of first-order partial differential equations. The nature of a particle is defined by a spinor or tensor amplitude attached to a corpuscular function. The proper interactions of a particle can also be described by the model. (T.F.H.)

16950 (NP-11592(Vol.I)(p.191-5)) LA METHODE DES PROCESSUS QUASI REELS EN PHYSIQUE DES HAUTES ENERGIES. (A Method of Quasi-Real Processes in High-Energy Physics). P. Kessler (Collège de France, Paris. Laboratoire de Physique Atomique et Moléculaire).

An approximate method is presented that is valid for interactions of highly relativistic particles. The method is based on a determination of the spectra associated with simple Feynman diagrams having one vertex and three lines. Results are presented for photon emission from relativistic bosons and fermions, and for relativistic boson pair and fermion pair photoproduction. The applications of this method to Dalitz pairs, bremsstrahlung, properties of muons and electrons, pair photoproduction on nuclei, and pion pair production are noted. (T.F.H.)

16951 (NP-11592(Vol.I)(p.197-200)) DISINTEGRATION β DES HYPERONS Λ^0 ET Σ^-. (β Decay of Λ^0 and Σ Hyperons). B. Aubert, V. Brisson, J. Hennessy, et al. (Paris. École Polytechnique).

Six β decays of Λ^0 hyperons are observed out of 3000 decays and the β-decay branching ratio is calculated to be $(0.30 \pm 0.15)\%$. Out of 254 Σ^- decays, no β decays are observed. (T.F.H.)

16952 (NP-11592(Vol.I)(p.203-7)) REACTION $\pi^- + p \to \Lambda^0 + K^0$ AUX SEUILS POUR LES REACTIONS $\pi^- + p \to \Sigma^{0-} + K^{0+}$ (CUSP). (Reaction $\pi^- + p \to \Lambda^0 + K^0$ at the Thresholds for $\pi^- + p \to \Sigma^{0-} + K^{0+}$ (Cusp) Reactions). F. Eisler (Brookhaven National Lab., Upton, N. Y.); J. M. Gaillard, J. Keren, M. Schwartz, and S. E. Wolf (Columbia Univ., New York).

The angular distributions from the reaction $\pi^- + p \to \Lambda^0 + K^0$ are measured at π^- energies of 890 to 914 Mev, i.e., near the threshold for $\Sigma^{0-} + K^{0+}$ production, in an attempt to determine the Λ-Σ relative parity. It is found, however, that the $\Lambda^0 + K^0$ production reaction is probably governed by complex D and F wave interactions, rather than by simple S and P waves. It is thus concluded that the relative Λ-Σ parity cannot be resolved by a study of this reaction. (T.F.H.)

16953 (NP-11592(Vol.I)(p.209-15)) AN EXPERIMENTAL TEST OF THE SELECTION RULE $\Delta Q = \Delta S$. P. P. Ely, W. M. Powell (California. Univ., Berkeley); M. Baldo Ceolin, E. Calimani, S. Ciampolillo, O. Fabbri, F. Farini, C. Filippi, H. Huzita, G. Miari (Padua. Università. Instituto di Fisica); W. Camerini, W. F. Fry, and S. Natali (Wisconsin. Univ., Madison).

An experiment was conducted to test the selection rule $\Delta Q = \Delta S$ by means of leptonic decays of neutral K mesons. Experimental results are discussed and it is concluded that the rule is probably not valid. (J.R.D.)

16954 (NP-11592(Vol.I)(p.227-34)) DISINTEGRATIONS DE K_2^0 DANS UNE CHAMBRE DE WILSON. (K_2^0 Decay in a Wilson Chamber). A. Astier, L. Blaskovic, M. M. De Courreges, B. Equer, A. Lloret, P. Rivet, and J. Siaud (Paris. École Polytechnique).

The half lives for electronic and muonic decay modes of the K_2^0 meson are calculated to be 35 ± 12 and 62 ± 17 nsec respectively. The branching ratios for K_2^0 decay modes of the type $3\pi^0$, $\pi^+\pi^-\pi^0$, $\pi^\pm e^\pm\nu$, and $\pi^\pm\mu^\mp\nu$ are measured. (T.F.H.)

16955 (NP-11592(Vol.I)(p.235-9)) K^0 INTERACTIONS. D. Luers, I. S. Mittra, W. J. Willis, and S. S. Yamamoto (Brookhaven National Lab., Upton, N. Y.).

An experiment is described in which a K_2^0 beam made by a 1.25-Bev π^- striking a CH_2 target is used at about 200 to about 650 Mev. The beam was designed to produce a reasonable K_2^0 flux at as low energy as possible. A list of reactions which might occur in the experiment are tabulated, and data on K_2^0-P interactions and cross sections for hyperon-pion production by K_2^0 are presented graphically. Other curves show momentum dependence. (J.R.D.)

16956 (NP-11592(Vol.I)(p.241-5)) K^0 DECAYS. D. Luers, I. S. Mittra, W. J. Willis, and S. S. Yamamoto (Brookhaven National Lab., Upton, N. Y.).

Results of a study concerning the decay of K_2^0-mesons conducted in a 20-in. H bubble chamber are presented. (J.R.D.)

16957 (NP-11592(Vol.I)(p.247)) K^+–NUCLEON TOTAL AND DIFFERENTIAL CROSS-SECTIONS IN THE MOMENTUM RANGE 0.8–2.9 Bev/c. V. Cook, D. Keefe, L. Kerth P. Murphy, W. Wenzel, and T. Zipf (California. Univ., Berkeley. Lawrence Radiation Lab.).

Data on the total K^+-proton cross sections at 0.8 to 2.9 Bev were determined by transmission of K^+ through liquid H. The K^+-neutron cross sections were measured by filling the target with deuterium. Both of these cross sections are approximately constant and equal to one another in this range at a value of 17 mb. The K^+-proton differential cross sections were also measured at 1.0, 1.2, and 2 Bev using the same target surrounded by spark chambers with Al foil plates. (J.R.D.)

16958 (NP-11592(Vol.I)(p.249-56)) FURTHER WORK ON $\pi\pi$ INTERACTIONS. A. R. Erwin, R. H. March, W. D. Walker, and E. West (Wisconsin. Univ., Madison).

Results of analyses concerning about 2000 2-prong π^--p interactions at 1.89 Bev are presented. (J.R.D.)

16959 (NP-11592(Vol.I)(p.257-64)) ETUDE DE L'INTERACTION π-π DANS LA DIFFUSION π^--p A 1.6 Gev/c. (Study of the π-π Interaction in π^--p Scattering at 1.6 Gev/c).

A kinematic analysis is made of interactions $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ at an incident π^- momentum of 1.6 Bev/c and low momentum transfer to the proton. The effective mass of the pion resonance is found for each event of this type, and the interaction cross section is found as a function of the effective mass. The final-state π^0-π^- angular distributions are found to correspond principally to a P-wave without spin-flip. (T.F.H.)

16960 (NP-11592(Vol.I)(p.265-7)) EVIDENCE FOR A π-π RESONANCE. [PART] I. E. Pickup, D. K. Robinson, and E. O. Salant (Brookhaven National Lab., Upton, N. Y.).

Data are presented which were obtained in analysis of results of events caused by the incidence of 1.25 Bev negative pions on an H bubble chamber. (J.R.D.)

16961 (NP-11592(Vol.I)(p.269-75)) ANTIPROTON ANNIHILATIONS AT REST INTO TWO CHARGED PIONS. G. B. Chadwick, W. T. Davies, M. Derrick, J. H. Mulvey, D. Radojicic, C. A. Wilkinson (Oxford Univ. Clarendon Lab.); M. Cresti, S. Limentani, A. Loria, and R. Santangelo (Padua. Università. Istituto di Fisica).

Film on the stopping region of antiproton exposure in a 80-cm H bubble chamber was used to study annihilations which give rise two visible charged pions. (J.R.D.)

16962 (NP-11592(Vol.I)(p.277-82)) THREE-PION RESONANCES IN π^+–D REACTIONS. A. Pevsner, R. C. Kraemer, M. Nussbaum, P. Schlein, T. Toohig (Johns Hopkins Univ., Baltimore); M. Block, A. Kovacs, and C. Meltzer (Northwestern Univ., Evanston, Ill.).

Details concerning the reactions $\pi^+ + D \rightarrow P_{spec} + p +$ (neutrals), $\pi^+ + D \rightarrow P_{spec} + p + \pi^+ + \pi^0 + \pi^-$, and $\pi^+ + D \rightarrow P_{spec} + n + \pi^+ + \pi^-$ are presented. (J.R.D.)

16963 (NP-11592(Vol.I)(p.283-6)) ANTIPROTON-PROTON TOTAL CROSS-SECTIONS BETWEEN 0.58 AND 5.3 Gev/c. U. Amaldi, V. T. Cocconi, T. Fazzini, G. Fidecaro, G. Ghesquiere, M. Legros, and H. Steiner (European Organization for Nuclear Research, Geneva).

Measurements of total $\bar{p}$-p cross sections in the energy range $165 \leq T_p - \leq 4400$ Mev are reported. Results show that the cross section decreases smoothly with increasing energy. (J.R.D.)

16964 (NP-11592(Vol.I)(p.291-4)) THE ELASTIC SCATTERING AND ABSORPTION OF 5.7 Gev/c π^- ON EMULSION NUCLEI. B. Jongejans (Amsterdam. Universiteit. Zeeman Laboratorium).

Results are given from an experiment in which a beam of momentum-selected pions (5.7 ± 0.1 Bev) was sent into a nuclear emulsion stack. (J.R.D.)

16965 (NP-11592(Vol.I)(p.295-9)) UNE NOUVELLE METHODE POUR DETERMINER LA POLARISATION DES POSITRONS. (A New Method for Determining Polarization of Positrons). L. Dick, L. Feuvrais, L. Madansky, and V. L. Telegdi (European Organization for Nuclear Research, Geneva).

The polarization of positrons may be determined by causing the positrons to fall on an amorphous or liquid substance in a magnetic field. Because of the presence of the field and the polarization, the populations and lifetimes of the m = 0 singlet and triplet positronium states are altered from their zero-field zero-polarization values. Analysis of the time-resolved spectrum of m = 0 positronium annihilation yields the polarization of the incident positrons. (T.F.H.)

16966 (NP-11592(Vol.I)(p.301-5)) USE OF A 200 KILOGAUSS PULSED MAGNETIC FIELD FOR BENDING HIGH ENERGY PARTICLES IN NUCLEAR EMULSIONS. L. Hoffmann and J. C. Combe (European Organization for Nuclear Research, Geneva).

Results of 600-μ-thick nuclear emulsion exposures to a momentum-analyzed proton beam are reported. The effects of a 180-kilogauss pulsed magnetic field was observed. It was concluded that the magnetic curvature of high energy particles entering the stack parallel to the pellicle can be measured with a small error. Ways of improving accuracy are discussed. (J.R.D.)

16967 (NP-11592(Vol.I)(p.307-25)) CONDITIONS D'UTILISATION DE LA TECHNIQUE DES «CIBLES INCORPOREES» AUX EMULSIONS NUCLEAIRES DANS LES MESURES DE DIFFUSION SIMPLE ET DE DIFFUSION COULOMBIENNE MULTIPLE. (Conditions for Utilizing the "Incorporated Target" Technique with Nuclear Emulsions in Measurement of Sample Scattering and Multiple Coulomb Scattering). L. Avan, M. Avan, J. Fain, and P. Y.

Bertin (Clermont-Ferrand, France. Université. Laboratoire de Physique Nucleaire et Corpusculaire).

The incorporation of powdered or plane-parallel filamentary targets into a nuclear emulsion that is on the order of 500 μ thick is considered. Deformation in the congealed emulsion caused by the presence of the target material is studied, and the effects of the deformations on the particle trajectories are described. Data are given for simple scattering by targets of Mo, Au, Cu, Ag, and Pt. Factors influencing the use of incorporated targets in studies of multiple Coulomb scattering are detailed. (T.F.H.)

16968 (NP-11592(Vol.I)(p.327-30)) THE ANALYTIC STRUCTURE OF SCATTERING AND REACTION AMPLITUDES IN UNPHYSICAL RIEMANN SHEETS. P. G. O. Freund and R. Karplus (Vienna. Universität. Institut für Theoretische Physik).

Aspects of scattering and reaction amplitudes in a second unphysical Riemann surface sheet are studied by analytic continuation around the branching point they possess at zero kinetic energy. (J.R.D.)

16969 (NP-11592(Vol.I)(p.331-5)) SOME RESULTS ON $\pi\pi$ INTERACTION PHASE SHIFTS. M. Jacob, G. Mahoux, and R. Omnes (France. Commissariat à l'Energie Atomique. Centre d'Études Nucléaires, Saclay).

The solution of Chew-Mandelstam equations for a scattering is presented. The position and width of the I = 1, J = 1$\pi\pi$ resonance and the coupling constant λ in S states are taken as given parameters in the solutions. (J.R.D.)

16970 (NP-11592(Vol.I)(p.337-42)) SINGULARITIES IN PARTIAL WAVE AMPLITUDES FOR TWO INGOING AND TWO OUTGOING PARTICLES. J. Kennedy and T. D. Spearman (London. Univ., University Coll.).

An investigation was conducted on the analytical properties of partial wave amplitudes for various interaction processes involving two ingoing and two outgoing particles. The singularities arising from cuts and poles lying along the real axis and a cut along a circle centered at the origin in the case of four unequal masses are considered from the standpoint of energy spectra. The singularities in the partial wave amplitudes to which these give rise are also considered. (J.R.D.)

16971 (NP-11592(Vol.I)(p.343-6)) ON PION-PION SCATTERING. B. H. Bransden (European Organization for Nuclear Research, Geneva); and J. W. Moffat (RIAS. Div. of Martin Co., Baltimore).

Results are presented on low energy S and P wave pion-pion elastic scattering amplitudes. The data were obtained by extending the range of coupling constants used for earlier calculations which were derived by iteration of a set of coupled equations from dispersion relations for the inverse partial wave amplitudes employing elastic unitarity on the right cut and calculating the discontinuity across the left cut by crossing symmetry. (J.R.D.)

16972 (NP-11592(Vol.I)(p.347-9)) ON THE NUCLEON-NUCLEON POTENTIAL. D. Amati, W. N. Cottingham, and R. Vinh Mau (European Organization for Nuclear Research, Geneva).

Results concerning the N-N potential obtained at CERN are presented. The intermediate region is emphasized. (J.R.D.)

16973 (NP-11592(Vol.I)(p.351-4)) LOW ENERGY PION-NUCLEON SCATTERING AND PION-PION INTERACTIONS. J. Hamilton, P. Menotti, T. D. Spearman, and W. S. Woolcock (London. Univ. University Coll.).

An analysis is presented concerning low energy S-wave π-N scattering. The analytic properties of the partial wave amplitudes are used with the variables $S = (\sqrt{M^2 + q^2} + \sqrt{\mu^2 + q^2})^2$ where M and μ are nucleon and pion masses, q is the C.M. momentum, and S is the square of the energy in the C.M. system. (J.R.D.)

16974 (NP-11592(Vol.I)(p.355-8)) $\overline{K}$N AND KN ENERGY DEPENDENT S-WAVE SCATTERING LENGTHS. F. Paccanoni and E. Pagiola (Padua. Università. Istituto di Fisica).

The phenomenonological residues given in π Compton's length are tabulated for $(KN)_0$, $(\overline{K}N)_1$ and $(KN)_1$. Errors in experimental data are such that no stringent conclusion can be reached. It appears that the pion force is relevant, however this force could not be identified. (J.R.D.)

16975 (NP-11592(Vol.I)(p.359-61)) INTERACTIONS OF 800 Mev/c K^--MESONS IN EMULSION. J. P. Lagnaux (Brussels. Université).

A stack of Ilford K_5 emulsion was exposed to a separated K^--meson beam at 800 Mev. Preliminary results are presented on a sample of 176 stars found by line scanning in a total track length of 58 meters. The corresponding interaction mean free path, corrected for the μ-meson beam contamination, is $\lambda = (29.5 \pm 2.6)$ cm. (J.R.D.)

16976 (NP-11592(Vol.I)(p.363-9)) ON THE PRODUCTION OF HYPERFRAGMENTS FROM THE INTERACTIONS OF 800 Mev/c K^- MESONS WITH EMULSION NUCLEI. B. D. Jones, B. Sanjeevaiah, J. Zakrzewski (Bristol Univ., England. H. H. Wills Lab.); M. Csejthey-Barth; J. P. Lagnaux, Sacton (Brussels. Université. Laboratoire de Physique Nucléaire); M. J. Beniston, E. H. S. Burhop, and D. H. Davis (London. Univ. University Coll.).

Preliminary results are presented on emission of hyperfragments from emulsion nuclei disintegrations produced by K^- mesons in flight. (J.R.D.)

16977 (NP-11592(Vol.I)(p.371-4)) INELASTIC HYPERON PRODUCTION WITH 1.89 Bev/c π^-. A. K. Erwin, R. H. March, and W. D. Walker.

Included are data on Σ-K-π cases and observations on production of the Λ-K-π systems. (J.R.D.)

16978 (NP-11592(Vol.I)(p.375-83)) PRODUCTION DE PARTICULES ETRANGES DANS LES INTERACTIONS π^- + p A 1,6 Gev/c. (Production of Strange Particles in π^- + p Interactions at 1.6 Gev/c).

Kinematic studies (angular distributions, mass distributions, phase–space analyses, etc.) are carried out on interactions in which a 1.6-Bev/c π^- interacts with a proton to produce $\Lambda^\circ + K^\circ$, $\Sigma^- + K^+$, $Y + K + \pi$, $\Lambda + K + \pi$, or $\Sigma + K + \pi$. The effects of a complex resonance Y^* are considered. (T.F.H.)

16979 (NP-11592(Vol.I)(p.385-8)) ETUDE PAR COMPTEURS DE LA PRODUCTION DES HYPERONS AU COURS DES COLLISIONS π-p. (Study with Counters of Hyperon Production in the Course of π-p Collisions). J. D. Dowell, B. Leontic, A. Lundby, R. Meunier, G. Petmezas, J. P. Stroot, and M. Szeptycka.

The interaction $\pi^- + p \rightarrow Y^- + K^+$ is analyzed at π^- momenta of 1 to 5 Bev/c. Resonances are observed in the Y^- state having masses of about 1190 Mev (Σ^-), 1385 Mev (Y^1_{-1}), and 1580 Mev (Y^2_{-2}). (T.F.H.)

16980 (NP-11592(Vol.I)(p.389-94)) REMARKS ON THE HYPERON-PION RESONANCES (Y^*) AND THEIR EFFECTS IN THE ABSORPTION OF K^- MESONS BY COMPLEX NUCLEI. Y. Eisenberg (Weizmann Inst. of Science, Rehovoth, Israel) and D. Kessler (Israel. Atomic Energy Establishment, Rehovoth).

An analysis of Y parity is presented. The effects of Y in

K^- meson absorption on complete nuclei are also discussed. (J.R.D.)

16981 (NP-11592(Vol.I)(p.397-406)) ELASTIC AND INELASTIC PROTON-PROTON SCATTERING BETWEEN 12 AND 27 GeV. G. Cocconi, A. N. Diddens, E. Lillethun, G. Manning, A. E. Taylor, T. G. Walker, and A. M. Wetherell (European Organization for Nuclear Research, Geneva).

A note is presented to point out that the present emulsion evidence on K^- capture at rest cannot be used as supporting proof for the existence of a Y isobar of mass 1405 Mev. (J.R.D.)

16982 (NP-11592(Vol.I)(p.407-17)) PERIPHERAL OR QUASI-ELASTIC INTERACTIONS OF 24 GeV PROTONS AND 16 GeV/c NEGATIVE PIONS IN HYDROGEN. D. R. O. Morrison (European Organization for Nuclear Research, Geneva).

Results of projection table measurements are presented of two-prong-events obtained in the CERN 32-cm diameter H bubble chamber with a 24-Bev proton beam. Only inelastic events are considered. Results of two-prong-events produced in the CERN 32-cm H chamber by a beam of 16-Bev negative pions are also presented. (J.R.D.)

16983 (NP-11592(Vol.I)(p.419-25)) INELASTIC PROTON-PROTON SCATTERING AT SMALL ANGLES. P. J. Duke (Gt. Brit. National Inst. for Research in Nuclear Science, Harwell, Berks, England); G. B. Chadwick, G. B. Collins, T. Fujii, N. C. Hien, and F. Turkot (Brookhaven National Lab., Upton, N. Y.).

An experiment is described in which momentum spectra of protons scattered at angles from 2 to 17° were obtained for nominal incident energies of 1.3, 2.0, and 2.8 Bev. (J.R.D.)

16984 (NP-11592(Vol.I)(p.433-47)) PION PRODUCTION BY 24 Gev/c PROTONS IN HYDROGEN. P. Dodd, M. Jobes, J. Kinson, B. Tallini (Birmingham. Univ., England); B. R. French, H. J. Sherman, I. O. Skillicorn (Imperial Coll. of Science and Tech., London); W. T. Davies, M. Derrick, and D. Radojicic (Oxford Univ. Clarendon Lab.).

Preliminary photographic measurement results are presented from exposure of a 30-cm H bubble chamber to 24-Bev protons. 350 interactions were measured. Resulting data are given on multiplicity distribution, cross-sections, and inelastic events. (J.R.D.)

16985 (NP-11592(Vol.I)(p.449-52)) THE MOMENTUM SPECTRUM OF SLOW PROTONS EMITTED IN HYDROGEN-LIKE INTERACTIONS OF NEGATIVE PIONS OF 6 AND 18 Gev/8. G. Bellini, E. Fiorini, A. J. Herz, et al. (Milan. Universita. Istituto di Fisica and Italy. Istituto Nazionale di Fisica Nucleare, Milan).

An analysis is presented of H-like interactions in a propane-freon chamber produced by negative pions at 6 and 18 Bev. (J.R.D.)

16986 (NP-11592(Vol.I)(p.453-7)) ANALYSIS OF LOW-MULTIPLICITY JETS PRODUCED BY HIGH-ENERGY PIONS. W. B. Fretter, T. F. Hoang (Paris. Ecole Polytechnique); G. Bellini, et al. (Milan. Universitá. Istituto di Fisica and Italy. Istituto Nazionale di Fisica Nuclear Milan).

An analysis of events obtained by exposure of a propane-freon chamber to negative pions at 6.1 and 18.1 Bev is presented. Criteria for event selection are given and data are presented graphically. A tabulation of event classification is included. (J.R.D.)

16987 (NP-11592(Vol.I)(p.459)) THE PARAMETERS OF LOW ENERGY PION PHYSICS. W. S. Woolcock (London. Univ. University Coll.).

Results obtained in best fit determinations of the parameters F^2, S-wave scattering lengths A_1 and A_3, S-wave phase shift curvatures at threshold, and p-wave scattering lengths A_{11}, A_{13}, A_{31}, and A_{33} are presented. (J.R.D.)

16988 (NP-11592(Vol.I)(p.461)) PION-NUCLEON PHASE SHIFTS UP TO ABOUT 350 MeV. W. S. Woolcock (London. Univ. University Coll.).

Data on S- and p-wave $\pi-N$ scattering amplitudes with relativistic corrections included are presented. (J.R.D.)

16989 (NP-11592(Vol.I)(p.467-83)) ANALYSIS OF PION-NUCLEON INTERACTIONS FROM 500 TO 1200 MeV. Roland Omnes and Georges Valladas (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay).

Sets of data on pion-nucleon iteractions at 400 to 1500 Mev are analyzed in an effort to clarify reaction mechanisms. Conclusions concerning resonances and production momenta are listed and recommendations concerning future investigations are included. (J.R.D.)

16990 (NP-11592(Vol.I)(p.503-6)) NEW ISOBARIC SPIN GROUP. L. De Broglie, D. Bohm, F. Halbwachs, P. Hillion, T. Takabayasi, and J. P. Vigier.

An analysis of a new spin group is presented starting with the idea that particles are not delta-functions but rather (classically) material distributions enclosed in time-like tubes. A theory of interactions is evolved, following which a scheme for strong interactions is obtained and by introduction of a parity operator four-fermion interactions and weak interactions are obtained. (J.R.D.)

16991 (NP-11592(Vol.I)(p.485-6)) APPLICATIONS OF THE DISPERSION RELATIONS FOR π N FORWARD SCATTERING. G. Hohler, G. Ebel, and J. Zwingenberger (Karlsruhe, Germany. Technische Hochschule. Institut für Theoretische Kernphysik).

16992 (NP-11592(Vol.I)(p.487-501)) ON THE EXPERIMENTAL POSSIBILITIES WITH COLLIDING BEAMS OF ELECTRONS AND POSITRONS. R. Gatto (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

A summary of activities in programs to produce electron-proton collisions at 250 Mev (500 Mev total center of mass energy), and to produce similar collisions at a total c.m. energy of 1 Bev. Discussions of quantum electrodynamics, annihilation, vector mesons, and weak interactions are included. (J.R.D.)

16993 (NP-11592(Vol.II)) THE AIX-EN-PROVENCE INTERNATIONAL CONFERENCE ON ELEMENTARY PARTICLES, SEPTEMBER 14-20, 1961. VOLUME II. PLENARY SESSIONS. E. Cremieu-Alcan, P. Falk-Vairant, and O. Lebey, eds. (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 210p.

Twelve papers are included, two of which are presented in French. A separate abstract was prepared for each paper. (J.R.D.)

16994 (NP-11592(Vol.II)(p.3-13)) LA PHYSIQUE DES LEPTONS. (Lepton Physics). R. L. Garwin (Watson Scientific Computing Lab., New York and Columbia Univ., New York).

A discussion is presented concerning the dipole moment of μ^- mesons, and magnetic moment, and helicity of μ mesons. Other sections contain information on μ meson decay, and capture. Information is also included on decay rate of μ^- mesons bound to Fe and a proposed experiment on weak magnetism. (J.R.D.)

16995 (NP-11592(Vol.II)(p.15-19)) LEPTON PHYSICS. T. D. Lee.

A summary of the theoretical descriptions concerning mesons μ^+, electrons, and neutrinos is presented and questions concerning leptons which have recently been posed are discussed. (J.R.D.)

16996 (NP-11592(Vol.II)(p.21-31)) ELECTRIC STRUCTURE OF NUCLEONS. Robert R. Wilson (Cornell Univ., Ithaca, N. Y.).

A review of progress on establishing characteristics of the proton and neutron is presented. The gross characteristics of these particles seem to be that the neutron and proton are states of a fundamental nucleon (charge independence); meson-like clouds exist which are dependent on the resonant state of the 2-pion system. A third area to be characterized, the core, is just emerging from the shadows of theory. (J.R.D.)

16997 (NP-11592(Vol.II)(p.33-55)) ELECTROMAGNETIC STRUCTURE OF PIONS AND NUCLEONS. S. Fubini (Padua. Universita. Istituto di Fisica and European Organization for Nuclear Research, Geneva).

A discussion of form factors and their applications is presented, and general properties deducted from theory for use in phenomenological treatments are examined. The various theoretical approximations required for extraction to form factors are also examined and recent phenomenological considerations of nucleon form factors are compared with experimental evidence. (J.R.D.)

16998 (NP-11592(Vol.II)(p.57-85)) LES ISOBARES DES NUCLEONS ET LES ETATS RESONNANTS DES SYSTEMES DE PLUSIEURS MESONS π. (The Isobars of Nucleons and Resonance States of Systems of Many π Mesons). J. F. Detceuf.

Discussions are presented concerning the characteristics of A, B, C and D isobars of π mesons. Production of π mesons by proton-proton collision is described along with gamma-proton interactions, π meson-proton interactions, and proton-deuteron interactions. Other information is given on antiproton annihilation, and data concerning π meson isobars and the resonances of several π systems are tabulated. (J.R.D.)

16999 (NP-11592(Vol.II)(p.87-102)) LOW ENERGY PION PHYSICS. P. T. Matthews (Imperial Coll. of Science and Tech., London).

A summary of pion physics aspects is presented to draw attention to the types of experiment which could throw the most light on the situation at present. Since there is no true pion interaction theory a semi-phenomenological analysis, which correlates the maximum amount of data with the minimum number of parameters is attempted. The main tools are the restrictions imposed by the conservation of angular momentum and isotopic spin, the unitarity of S-matrix (conservation of probability), the relativistic covariance of the theory, and causality. (J.R.D.)

17000 (NP-11592(Vol.II)(p.103-24)) HIGH ENERGY PHYSICS ABOVE 10 GeV. Ch. Peyrou (European Organization for Nuclear Research, Geneva).

Information on interactions of elementary particles at high energy is presented. The production processes in high energy collisions are emphasized. Results by use of high-energy machines up to the present time are reviewed and a description of methods being developed to interpret the interactions is examined. (J.R.D.)

17001 (NP-11592(Vol.II)(p.125-39)) HIGH ENERGY PHYSICS ABOVE 10 Gev. S. D. Drell (Stanford Univ., Calif. and European Organization for Nuclear Research, Geneva).

A discussion is presented on collisions of strongly interacting particles at energies above 10 Bev. The processes involved in such events are generally characterized as high-energy, low momentum transfer collisions. (J.R.D.)

17002 (NP-11592(Vol.II)(p.141-9)) THE BOTANY OF STRANGE PARTICLES. R. K. Adair (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.).

A summary of work on strange particles is presented. The discussion is organized in terms of weak interactions of strange particles divided further into leptonic decays and nonleptonic decays; and the strong interactions. (J.R.D.)

17003 (NP-11592(Vol.II)(p.151-75)) SOME TOPICS IN STRANGE PARTICLE PHYSICS. R. H. Dalitz (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies).

A discussion is presented on the status of experimental indications on the K-parity and Σ-parity. The Y_1 and Y_0 resonance states are also examined. (J.R.D.)

17004 (NP-11592(Vol.II)(p.177-89)) EXPERIMENTAL STATUS OF STRANGE ISOBARS. F. T. Solmitz.

A summary of new developments in resonances (isobars) particularly those involving strange particles is presented. Data are tabulated on strange isobars and discussions are included concerning the Y_1 1385-Mev isobar, the 1405-1525- and 1815-Mev $I = 0$ isobars. The 885-Mev K-resonance is also discussed. (J.R.D.)

17005 (NP-11592(Vol.II)(p.191-204)) STRANGE ISOBARS. Abdus Salam (Imperial Coll. of Science and Tech., London).

A discussion is presented centered around theoretical models of the resonances associated with the K-mesons and the strange isobars Y_1 and Y_0. (J.R.D.)

17006 (UCRL-10118) THE MEAN LIFE OF THE NEUTRAL PI MESON (thesis). Maung Hla Shwe (California. Univ., Berkeley. Lawrence Radiation Lab.). June 1962. Contract W-7405-eng-48. 67p.

The proper mean life of the neutral pion was measured by a method utilizing a large relativistic time dilation. Negative pions of 3.5 Bev/c were allowed to make interactions in Ilford K.5 nuclear research emulsions. Among 3600 interactions, 103 neutral pions decaying by the Dalitz mode $\pi^0 \rightarrow (e^+ + e^-) + \gamma$ were found. The π^0 path lengths could be accurately measured, and were automatically calculated by specially developed microscope equipment. It was assumed that the π^0 momentum spectrum is the same as that of the secondary charged pions found by multiple scattering measurements. The mean transverse momentum of secondary charged pions at all angles was 274 ± 10 Mev/c. The opening-angle distribution of the electron pairs was measured and compared with extensive calculations of the expected laboratory distribution, in order to estimate the number of unobserved events. The mean life (τ_{π^0}) of the π^0 was evaluated statistically. The maximum-likelihood estimate is $\tau_0 = 2.0^{+0.4}_{-0.3} \times 10^{-16}$ sec. Systematic errors were carefully eliminated and their residual effect is thought to be small. The significance of the measured π^0 mean life for various theories is reviewed. (auth)

17007 SINGLE VALUEDNESS OF WAVE FUNCTIONS. E. Merzbacher (Oak Ridge National Lab., Tenn. and Univ. of North Carolina, Chapel Hill). Am. J. Phys., 30: 237-47 (Apr. 1962).

The requirement that the quantal wave function be single-valued is examined in the light of the effect of a magnetic vector potential on a particle moving in a multiply-connected field-free region (Aharonov-Bohm effect) and the flux quantization inside a superconducting ring. These effects are applications of conventional elementary quantum mechanics. The single-valuedness problem is considered, with its historical background, for particles with no spin, particles with spin $1/2$, and rigid bodies. The single-valuedness condition, if properly adapted to the particular physical model, is deeply rooted in the foundations of quantum mechanics. However, wave functions which superficially appear to be double-valued are useful in an helicity representation of spinors and in the construction of nuclear wave functions. (auth)

17008 ELEMENTARY THEORY OF RESONANCE SCATTERING. B. W. Downs (Univ. of Colorado, Boulder). Am. J. Phys., 30: 248-55(Apr. 1962).

Elastic scattering by a spherically symmetric potential is discussed in terms of a partial-wave analysis in which the phase shifts do not appear explicitly. The resonance structure of the scattering amplitude is more evident than in the usual phase-shift analysis. The resonance structure is discussed and the connection of the formalism with that of Kapur and Peierls is established. (auth)

17009 ELECTROMAGNETIC FIELDS OF A CHARGE AND ISOTROPIC MEDIUM IN RELATIVE MOTION. L. Diesendruck (General Dynamics Electronics, Rochester, N. Y.). Am. J. Phys., 30: 256-65(Apr. 1962).

The electromagnetic potentials and fields of a charge and an isotropic dielectric medium in uniform relativistic motion are derived for charge at rest, medium moving; charge moving, medium at rest; and charge and medium moving. The electric displacement D is always radial, and the magnetic field intensity H is always proportional to the cross product of charge velocity and position vector. The electric field intensity E and the magnetic flux density B depend on the medium velocity in general. The approximations to low velocity result in a modification of the medium velocity by Fresnel's dragging coefficient. The superoptic case results in a conical region for real fields and radiation at the Cherenkov angle. (auth)

17010 THE CAPTURE OF PROTONS BY DEUTERONS. G. M. Griffiths, E. A. Larson, and L. P. Robertson (Univ. of British Columbia, Vancouver). Can. J. Phys., 40: 402-11(Apr. 1962).

The cross section and angular distribution of gamma rays for the reaction $D(p,\gamma)He^3$ were measured for proton energies from 0.275 to 1.75 Mev. For 275-kev protons the total cross section is 0.97 ± 0.11 μbarns and for 985-kev protons it is 3.5 ± 0.38 μbarns. The angular distribution has the form $(\sin^2 \theta + b)$ where b is small. b increases with decreasing proton energy, contrary to previous results, and the energy dependence of b and of the cross section suggests that the $\sin^2 \theta$ part of the cross section is due to the capture of p-wave protons and the b part is due to s-wave proton capture. (auth)

17011 SCHOOLING IN NUCLEAR ENGINEERING. III. RADIOACTIVITY. J. Hacke. Kerntechnik, 4: 120-3(Mar. 1962). (In German)

The units and definition of radioactivity are discussed. The laws of radioactive decay are outlined. Alpha, beta, and gamma radiation, conversion electrons, radiation from electron capture, and neutrons are described along with their sources. (M.C.G.)

17012 WIDTH OF PHOTON LINE PRODUCED BY POSITRON ANNIHILATION AT 15 Mev. C. R. Hatcher, R. L. Bramblett, N. E. Hansen, and S. C. Fultz (Univ. of California, Livermore). Nuclear Instr. & Methods, 14: 337-42(Jan. 1962). (In English)

The energy spread of the photon line produced by annihilation of 15-Mev positrons in a thin LiH target was measured. Positrons are produced by bombarding a Ta target with 10-Mev electrons from a linear accelerator. The positrons are accelerated to about 15 Mev in a second accelerator section and then energy-analyzed with a bending magnet-slit assembly. The photon line width measurement was made by counting the number of photons elastically scattered from the 15.11-Mev level of C^{12} as a function of positron energy setting. The annihilation photon line was found to have a full width at half maximum of 0.45 ± 0.05 Mev. An annihilation photon energy spectrum was calculated and found to be in agreement with experimental results. (auth)

17013 AN APPROACH TO A RELATIVISTIC STRONG COUPLING THEORY. Shoichi Hori (Universitet, Copenhagen). Nuclear Phys., 30: 644-63(Mar. 1962). (In English)

The vacuum expectation value of the S-matrix provides knowledge of all Feynman amplitudes and is equivalent to the S-matrix itself, if appropriate source functions are introduced. As the vacuum expectation value, S_{vac}, is a c-number quantity, it is often more convenient to treat S_{vac} than the S-matrix itself. Considered are: (i) two neutral scalar fields, ψ and ϕ, interacting through the interaction $g\psi\phi$; (ii) the charged scalar field interacting with an external neutral scalar field ϕ through $g\psi^*\psi\phi$; and (iii) interacting charged and neutral scalar fields ψ and ϕ through the interaction $g\psi^*\psi\phi$. Functional differential equations that S_{vac} should satisfy and in which the coupling constant g and the source functions are variables are considered. The solution is obtained in the form of an inverse power expansion of the coupling constant by solving the functional differential equations. In (i), the inverse power series is summed up, and the result agrees with the exact solution. In (ii), the only relevant Feynman amplitude is the modified propagator for the ψ-field, which is also expanded into an inverse power series of the coupling constant. In (iii), S_{vac} is expressed in a form involving only functional differentiations, but no more path integrals. If the functional differentiations are performed, the result will also be an inverse power series of the coupling constant. Extension to other cases is discussed. (auth)

17014 PRODUCTION OF PHOTONS IN HIGH ENERGY PION–NUCLEON COLLISIONS. W. Czyż (Inst. of Physical Research, Krakow, Poland). Nuclear Phys., 30: 680-2 (Mar. 1962). (In English)

It is shown that the one-pion exchange model of the peripheral high-energy pion-nucleon collision predicts the emission of linearly polarized photons with sharply peaked angular distribution which does not depend on the energy of produced photons. It is suggested that the existence of such photons could be considered as a test for the one-pion exchange model of peripheral collisions. (auth)

17015 BINDING ENERGIES OF Λ PARTICLES AND THE Λ-N INTERACTION. A. R. Bodmer and S. Sampanthar (Univ. of Manchester, Eng.). Nuclear Phys., 31: 251-92 (Mar. 1962). (In English)

The implications of Λ-binding energies for the Λ-nucleon interaction are considered when three-body forces are included in addition to two-body Yukawa forces. Light hypernuclei with baryon number ≤ 5 are considered. For ${}_{\Lambda}H^3$, the effect of three-body forces is small and may be obtained by a perturbation procedure; the binding energy of ${}_{\Lambda}H^3$ being almost entirely determined by the two-body forces. For ${}_{\Lambda}He^5$, the He^4 core is assumed to be undistorted by the Λ. The binding energies of ${}_{\Lambda}H^4$, ${}_{\Lambda}He^4$ do not seem capable of yielding significant information about the interaction strengths. The two-body system $_{\Lambda}H^2$ is not bound unless the three-body forces are very strongly attractive. The potential felt by a Λ in nuclear matter, this being considered as a Fermi gas, is calculated using perturbation theory. Both direct and exchange two-body forces are considered. The second order contributions, the effect of nuclear pair correlations, and the velocity dependence are all small. The nucleon exchange factor used for the three-body forces strongly suppresses their effect in nuclear matter. The implications of "empirical" values of the Λ-potential depth are considered. If the pion-baryon couplings predominate, strongly attractive three-body forces of not too large a range are favored, corresponding to a larger singlet than triplet two-body volume integral. (auth)

17016 THEORY OF PERIPHERAL INTERACTIONS OF FAST PARTICLES. V. S. Barashenkov, H. J. Kaiser, and Van-Pei (Joint Inst. for Nuclear Research, Dubna, USSR). Nuclear Phys., 31: 308-14(Mar. 1962). (In English)

The expression for the energy spectrum of peripheral mesons in a fast-moving nucleon is obtained. This spectrum corresponds to the expansion of the mesic field of a moving nucleon into plane waves and can be used for the calculation of inelastic fast-particle nucleon collisions. Within distant peripheral collisions, the theory coincides with the peripheral collision theory of Heitler and Peng. (auth)

17017 CANONICAL COMMUTATION RELATIONS FOR VECTOR FIELDS. Kenneth Johnson (Universitet, Copenhagen). Nuclear Phys., 31: 464-70(Apr. 1962). (In English)

The commutation rule $[\phi^k, j^0] = 0$ and its relation to the sum rule for the bare mass of a vector field is discussed. Consistency with perturbation theory is demonstrated. (auth)

17018 GENERAL THEORY OF THE GAUGE TRANSFORMATION FOR VECTOR MESON FIELDS. Michiji Konuma, Hiroomi Umezawa, and Morihiro Wada (Tokyo Univ.). Nuclear Phys., 31: 507-24(Apr. 1962). (In English)

The general theory of gauge transformations for multiplet vector fields is considered by extending the three-dimensional rotation group of the Yang-Mills type into any simple Lie group. The neutral vector theory, the Yang-Mills theory of the triplet field, and the Gell-Mann theory of the octad field are obtained as special cases of the general theory. Principal results concerning the latter theory are stated in the form of equivalence theorems. The theory is not renormalizable when the masses of the vector fields are not zero. General features of the theory are reviewed. (auth)

17019 ANALYTICITY OF THE GENERAL UNITARITY TERM. R. W. Lardner (Columbia Univ., New York). Nuovo cimento (10), 23: 323-7(Jan. 16, 1962). (In English)

A definition is given of those hypersurfaces in the space of the three-momentum transfers of a general amplitude in terms of which the unitary extension of analyticity takes a simple and natural form. (auth)

17020 ON THE PHASE-SPACE INTEGRAL. R. Ansari (Universität, Hamburg). Nuovo cimento (10), 23: 355-9 (Jan. 16, 1962). (In English)

Calculations of the phase-space integral were made on the basis of the saddle-point solution for the case of 25 Bev N-N collision. The results are compared with that of the Monte-Carlo method. (auth)

17021 ANALYTICITY AND UNITARITY. J. C. Polkinghorne (Cambridge Univ., Eng.). Nuovo cimento (10), 23: 360-7(Jan. 16, 1962). (In English)

It is shown that the structure of S-matrix singularities is controlled by unitarity. The minimum consistent set of singularities is that given by perturbation theory, provided a certain condition related to analyticity in external masses is assumed. (auth)

17022 ON LOCAL BUT NON-CAUSAL CURRENT OPERATORS IN S-MATRIX THEORIES. F. Kaschluhn (Humboldt-Universität, Berlin and Institut für Reine Mathematik der Deutschen Akademie der Wissenschaften, Berlin). Nuovo cimento (10), 23: 368-85(Jan. 16, 1962). (In English)

The existence of local but non-causal current operators in S-matrix theories is discussed from the standpoint of the functional derivative approach to quantum field theory. A model is proposed with a given current operator which is a local series in powers of a free field and a perturbation-theoretical example for which the S-matrix is given. No use is made of interacting field operators obeying some inhomogeneous wave equations. Some analytic properties of the scattering amplitude for the two models specialized and approximated in an appropriate form are also investigated. (auth)

17023 DISPERSION RELATIONS AND STABILITY CONDITIONS. A. Minguzzi and L. Taffara (CERN, Geneva). Nuovo cimento (10), 23: 386-91(Jan. 16, 1962). (In English)

In the axiomatic formulation it is shown that, in the non-exothermic case, the elastic scattering dispersion relations up to some positive momentum transfer follow only from the condition of stability of the external particles. (auth)

17024 S-WAVE AMPLITUDE FOR THE K-π SYSTEM. V. Amar, M. Lucchini, and C. Marioni (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan). Nuovo cimento (10), 23: 392-401(Jan. 16, 1962). (In English)

The S-wave amplitude of the K-π system is examined in double dispersion relations with the hypothesis of a $\overline{K}$-K-π interaction. The π-π P-wave resonant contribution to this amplitude is calculated and an integral equation is obtained whose numerical solution will provide some inference on the presence and features of the K-π resonance. (auth)

17025 THE K-MESON-PION SCATTERING. A. P. Balachandran (Univ. of Madras). Nuovo cimento (10), 23: 402-407(Jan. 16, 1962). (In English)

The influence of the K-π and π-π resonances on the p-wave K-π scattering in the $T = \frac{1}{2}$ state is investigated using double dispersion relations. For this, the singularities in the energy variables of the crossed processes are taken into account by assuming that the recently observed K-π resonance is in the p-state and approximating the contributions from the singularities of the crossed energy variables by the ones due to the corresponding K-π and π-π resonances of zero widths. (auth)

17026 DECAY RATE OF THE NEUTRAL PION. S. K. Bose (Univ. of Rochester, N. Y.). Nuovo cimento (10), 23: 408-15(Jan. 16, 1962). (NYO-10028). (In English)

The method of Gell-Mann and collaborators to obtain the Goldberger-Treiman formula for the charged pion decay is extended to obtain the rate of neutral pion decay from a study of the Compton scattering of protons. (auth)

17027 FINAL STATE ENHANCEMENT FACTORS. J. D. Jackson and G. L. Kane (Univ. of Illinois, Urbana). Nuovo cimento (10), 23: 444-7(Jan. 16, 1962). (In English)

The enhancement of production cross-sections and modification of energy spectra due to attractive interactions between particles in the final state are theoretically discussed. The question of the final-state enhancement factor is considered in order to show that there is an alternative formula which may be used and to establish the negative conclusion that this alternative enhancement factor cannot alter significantly the existing interpretation by Watson. (N.W.R.)

17028 THRESHOLD MASS NUMEROLOGIES AND RESONANCES IN BOSON AND BARYON SYSTEMS. S. F. Tuan (Brown Univ., Providence). Nuovo cimento (10), 23: 448-52(Jan. 16, 1962). (In English)

Some of the more remarkable features between coincidences in mass thresholds for production of boson and baryon resonances and resonances in the baryon system are re-emphasized in connection with the cusp effect. The discussion is confined to three-body final states. The resonances are extremely narrow and consistent with zero width within experimental resolution. (N.W.R.)

17029 BARYON RESONANCES AS UNITARY MULTIPLETS. P. T. Matthews and A. Salam (Imperial Coll. of Science and Tech., London). Nuovo cimento (10), 23: 453-4(Jan. 16, 1962). (In English)

The gauge theories of unitary symmetry used in predicting the boson resonances are explored as a method for classifying the baryon resonances as unitary multiplets. The proposed assignments are tabularly presented, the multiplets being labeled by their multiplicity. The multiplets may be verified by the spin and parity assignments implied by the table. (N.W.R.)

17030 SOME CONSEQUENCES OF THE UNITARY SYMMETRY. A. Salam (Imperial Coll. of Science and Tech., London). Nuovo cimento (10), 23: 455-7(Jan. 16, 1962). (In English)

Multiplet characteristics of the K* particle are investigated. If the K* particle has spin-parity (1 –), this together with the recently discovered ρ and w particles (both also 1 –) may complete the set of vector mesons associated with a gauge theory of the unitary group. The multiplet characteristics are investigated from two non-equivalent versions of the basic fermion multiplet: the Sakata multiplet S consisting of p, n, and Λ; and the Gell-Mann–Neeman (G-N) multiplet consisting of N, Λ, Σ, and Ξ. Both versions of the theory lead to the same multiplets, M_1 and M_2, where M_1 consists of (w, ρ, and K*) and M_2 of ($\pi^{0'}$, π, and K). (N.W.R.)

17031 DISPERSIVE BONDS. Grzegorz Białkowski (Inst. of Theoretical Physics, Warsaw). Postępy Fiz., 12: 629-70(1961). (In Polish)

The assimilation and synthesis of the abundant experimental data being gathered on the interaction of elementary particles is hindered by the lack of a quantitative theory. A review of dispersion theory is presented in an effort to outline the present state of the theory, to emphasize the most successful aspects of dispersion theory, and to delineate the future prospects of theoretical development. Specifically, the presentation outlines the methods of double dispersion relations, after giving a review of "single" dispersion relations. The review is intended, in part, to serve as a guide to the numerous references given, references that have been selected as the most useful and illuminating from the vast amount of literature existing in this area. (TTT)

17032 ON THE STATE OF THE π-HYPERON RESONANCE. Marek Grynberg (Inst. of Nuclear Physics, Warsaw). Postępy Fiz., 12: 687-97(1961). (In Polish)

In the present state of experimental knowledge, one can obtain definite information about the interactions of hyperons and π-mesons only through the analysis of those reactions in which these particles are produced simultaneously, in the final state. The results of a series of experiments can be explained on the basis of the assumption that there exists an isobaric state of a hyperon of mass 1380 Mev, strangeness $S = -1$ and isotopic spin $I = 1$, which rapidly decays to a π-meson and a hyperon. The existence of such an isobar should indicate the existence of a resonance in π-hyperon scattering. The first part of the article deals with experimental findings pointing to the existence of a resonance state. In the second part, the predictions of several theories of strong interactions, as applicable to π-hyperon resonance, are compared with those features of the experimental results that characterize resonance. (TTT)

17033 ČERENKOV EFFECT UNDER THE INFLUENCE OF AN EXTERNAL MAGNETIC FIELD. A. M. Sayied (Univ. of Calcutta). Proc. Phys. Soc. (London), 79: 816-18(Apr. 1, 1962).

The Cherenkov effect for a charge in a circular orbit under the influence of an external magnetic field is discussed in terms of a parameter called the magnetic Cherenkov radius. A simple two-dimensional model is considered which yields physical features of the Cherenkov emission without going into detailed calculations. (auth)

17034 MANY-PARTICLE SYSTEMS: III. DETERMINATION OF THE GROUND STATE ENERGY OF A SYSTEM OF N PARTICLES INTERACTING BY ATTRACTIVE INVERSE SQUARE FORCES. H. R. Post (Chelsea Coll. of Science and Tech., London). Proc. Phys. Soc. (London), 79: 819-20(Apr. 1, 1962).

The energy of a system of N identical interacting particles may be found by considering the equivalent translation-invariant one-particle problem. This is illustrated in the case of attractive inverse-square force interaction. An upper and a lower limit for the ground-state energy is found immediately by integration over a single variable. The energy is determined within 8% and found to be proportional to the cube of the number of particles. (auth)

17035 ELECTRON CAPTURE BY α-PARTICLES IN HYDROGEN. R. McCarroll and M. B. McElroy (Queen's Univ., Belfast). Proc. Roy. Soc. (London), A266: 422-8 (Mar. 20, 1962).

A non-resonance charge-transfer reaction for α particles in hydrogen was investigated by the use of an expansion based on atomic eigenfunctions, full account being taken both of the non-orthogonality of the eigenfunctions of the initial and final atomic states and of the effect of distortion. Cross-sections for the reaction were computed for a range of incident particle energies from 50 to 1600 kev. The results indicate that the effect of distortion is considerable up to energies of 800 kev. Comparison is made with the results obtained when the effect of the non-orthogonality is ignored (with and without the inclusion of the nuclear-nuclear term in the interaction potential). (auth)

17036 OBSERVATION OF THE (π,π) RESONANCE IN THE PION PRODUCTION PROCESS. Tsuneyuki Kotani, Nobuhiko Mishima, and Minoru Monda (Tokyo Metropolitan Univ.). Progr. Theoret. Phys. (Kyoto), 27: 1-23(Jan. 1962). (In English)

Coincidence measurements among three final particles in a γ(or π) + N $\rightarrow$ N + 2π process are analyzed to determine a (π,π) resonance energy (ω_r). The energy of at least one of the final pions generally can be in the (3,3) resonance region of the π-N subsystem. Even in the (π,π) resonance state, it has no large influence on a pion energy spectrum. Qualitatively, this is why the isobar model can explain the pion energy spectrum. To detect the (π,π) resonance effect, the disturbance due to the π-N resonance states must be avoided. Conditions for two types of coincidence experiments are investigated kinematically. The π-π coincidence is useful if $\omega_\pi^2 < 15\mu^2$ or $>30\mu^2$, μ being the pion mass. If $\omega_\pi^2 > 18\mu^2$, the π-N coincidence experiment may be more adequate than the π-π coincidence one. Behaviors of the differential cross section on the γ-2π process, expected from the kinematical consideration, are checked by a model with a γ-3π vertex and by another including both the γ-3π vertex and the (3,3) resonance state in the static approximation. (auth)

17037 PION-PION INTERACTION. RESONANCES CORRESPONDING TO ρ- AND ω^0-PARTICLES. Shin Ishida (Nihon Univ., Tokyo) and Kazo Nakazawa. Progr. Theoret. Phys. (Kyoto), 27: 33-50(Jan. 1962). (In English)

The modified effective range formulas for S- and P-wave pion-pion scattering which contain the effect of nucleon closed loops are derived using the chain approximation. These are extensions along the lines of Chew and Mandelstam, and Okubo and Miyamoto. The resonance at ~700 Mev is predicted with a broad width of T/2 ~ 400 Mev for the I = l = 1 state and the resonance at ~300 Mev with a small width of T/2 ~ 20 Mev for the I = l = 0 state, consistent with experiment corresponding to ρ and ω^0 mesons. respectively. (auth)

17038 DISPERSION THEORETIC TREATMENT FOR NUCLEON-NUCLEON SCATTERING AT LARGE IMPACT PARAMETER. Susumu Furuichi (Rikkyo Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 27: 51-88(Jan. 1962). (In English)

A Chew-Mandelstam type integral equation for the nucleon-nucleon scattering is derived by assuming the analyticity properties of the scattering amplitude in the type of the Mandelstam representation, and the uncoupled equations are solved under the one-pion-exchange approximation provided that it is valid in the special region where the impact parameter is large enough. Comparison with semi-empirical phase shift given by Hamada and by Breit, et al., shows that the impact parameter may be a useful measure of the reliability in the dispersion theoretic approach as well as in the potential theoretic one. The one-pion-exchange contribution dominates the behavior of phase shift in the region where impact parameter is larger than 1.5 ~ 2 pion Compton wavelengths. In the same region, the two-pion and more massive states contributions can be approximated to a rather simple form which is absorbed in slight modification of the corresponding scattering length. The result of the pole approximation for the one-pion-exchange cut is very close to the exact one in the same region. The comparison in the ^{1}S-states shows that there is no region where the behavior of ^{1}S-phase shift is dominated by the one-pion-exchange contribution. It is also shown that partial wave expansion may be inappropriate for the evaluation of higher partial wave $(l \geqq 2)$, unless a further approximation is used. (auth)

17039 SOME ANALYTIC PROPERTIES OF ABSORPTIVE PART OF SCATTERING AMPLITUDE. Kunio Yamamoto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 27: 133-8(Jan. 1962). (In English)

By using the graphical interpretation of Dyson's integral representation of the causal commutator, it is shown that the absorptive part of the scattering amplitude has two singularities. One has the close connection with the maximum momentum transfer below which the dispersion relation holds, and the other has the close connection with the anomalous threshold. In the latter singularity, the scattering amplitude and the vertex function are the same situation in all respects. For example, if the dispersion relation holds and the threshold does not depend on the momentum transfer, even in the case where the anomalous threshold appears, the threshold of the dispersion relation of the scattering amplitude cannot be lower than that of the corresponding vertex function. (auth)

17040 K^--P REACTION AT THRESHOLD. Yoneji Miyamoto (Tokyo Univ. of Education). Progr. Theoret. Phys. (Kyoto), 27: 203-10(Jan. 1962). (In English)

The transition matrix for K^--p interactions is discussed. The scattering length for K^--p interaction is obtained in terms of the coupling constants between K^--p, π-Σ, and π-Λ channels. The relation between the branching ratio of Y^* and Σ/Λ ratio at threshold is derived. The large imaginary part of I = 0 scattering length is discussed under the assumption π-Σ $P_{1/2}$ resonance. The coupling constant of Fujii-Sakurai's vector meson is tentatively determined. (auth)

17041 REMARKS ON THE CORRESPONDENCE BETWEEN FIELD THEORIES WITH YUKAWA AND FERMI INTERACTIONS. Yasusi Ataka (Kinki Univ., Osaka). Progr. Theoret. Phys. (Kyoto), 27: 211-12(Jan. 1962). (In English)

The Z_3 value (Y. Ataka, Prog. Theor. Phys., 25: 895 (1961)) is calculated in the limit with vanishing probability amplitudes for bare mesons. Limits of validity are shown. (L.N.N.)

17042 RELATIVE $\Lambda\Sigma$-PARITY AND K^--p INTERACTIONS AT (1.1 ~ 1.4) Bev/c. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 27: 214-15(Jan. 1962). (In English)

Phenomena consistent with odd $\Lambda\Sigma$ parity are discussed from the kinematical standpoint. The reactions $\Sigma^+ + d \rightarrow \Sigma^0 + p + p$ and $\Sigma^+ + d \rightarrow \Lambda + p + p$ below 5 Mev are considered. If the angular distribution of Λ contains a large $\cos^2\theta$ term, the assumption of odd $\Lambda\Sigma$ parity is consistent with the result. In the reaction $K^- + p \rightarrow \Sigma + p \rightarrow \Sigma + \pi + \pi$, when the relative $\overline{K}\Sigma$ parity is even, the Σ and ρ are in a P state relative to each other because the ρ parity is odd. The existence possibilities of the Y_2^* in the proposed reaction $K^- + p \rightarrow Y_2^* + \pi + \pi$ at 1.15 Bev/c are discussed. (L.N.N.)

17043 K-$\overline{K}$ INTERACTION AND K MESON REACTIONS AT HIGH ENERGY. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 27: 215-17(Jan. 1962). (In English)

Regarding ω and ρ as bound states in the K-K^- system with isotopic spin T = 0 and 1, respectively, effects of ω and ρ on K^--N interactions are considered. Near the threshold energy for $K^- + N \rightarrow Y + \omega$ or $K^- + N \rightarrow Y + \rho$ production, K^--N cross sections may have a maximum. For $K^- + N \rightarrow Y^* + \omega$ or $K^- + N \rightarrow Y^* + \rho$, a maximum of different value may appear, but excitation energies are nearly equal. (L.N.N.)

17044 HEAVY MESONS AND HARD CORE IN NUCLEAR FORCE. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 27: 217-19(Jan. 1962). (In English)

It was experimentally observed that the number of K-K^- pairs in proton-antiproton annihilation is much smaller than the value predicted by statistical theory. This was attributed to the transition from the virtual K-K^- pair to the ω or ρ. A model in which ω and ρ are regarded as the bound S states in nucleon-antinucleon states is presented. It is assumed that the N-$\overline{N}$ force in the short range is strongly attractive, in the singlet and triplet S states, for spin and isotopic spin. The existence of a nucleonic hard core is assumed, in which the ω plays the more important role. Vector-type and tensor-type interaction effects on the nucleonic hard core are compared. (L.N.N.)

17045 PHYSICAL MEANING OF REDUNDANT POLES OF S-MATRIX. Kunio Yamamoto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 27: 219-21(Jan. 1962). (In English)

The redundant poles in $k = in\mu/2$ for $n = 1,2,3\ldots$ correspond to the thresholds of the intermediate states of the process $A + \overline{A} \rightarrow \overline{B} + B$. To judge whether the S-matrix pole corresponds to the bound state of $A + B \rightarrow A + B$, the partial wave amplitude for large angular momentum must be investigated. When the pole does not correspond to the bound state, the amplitude for large angular momentum always has the branch point at the same point. When the pole corresponds to the bound state, the large angular momentum amplitude is regular or has the pole. (L.N.N.)

17046 ON QUANTUM FIELD THEORY WITH INDEFINITE METRIC. Sho Tanaka (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 27: 221-2(Jan. 1962). (In English)

It is shown that under the threshold energy of fictitious-particle production, a satisfactory theory may be obtained in the sense of the correspondence principle, which is free from divergence, probabilistically interpretable, and satisfies the necessary condition of the macroscopic causality in which the scattering matrix of a system consisting of two non-interacting systems, α and β, must be the product of the physical scattering matrix of the two subsystems. (L.N.N.)

17047 APPLICATION OF THE DISPERSION RELATION TO THE K^+-p SCATTERING. Takesi Ebata and Atsushi Takahashi (Tohoku Univ., Sendai). Progr. Theoret. Phys. (Kyoto), 27: 223-5(Jan. 1962). (In English)

Dispersion relations are applied to K^+-p scattering amplitudes, and properties of the $KK\pi\pi$ interaction and the P-wave K^+-p scattering amplitude were investigated. It is assumed that the scattering amplitudes satisfy the Mandelstam representation, and an approximation (M. Cini and S. Tubini, Ann. Phys., 10: 352(1960)) is introduced. Terms containing the $KK\pi\pi$ interaction explicitly are separated, and effects on K^+-p scattering are obtained. (L.N.N.)

17048 STRANGENESS VIOLATING WEAK INTERACTIONS AND THE SPIN OF K. Hiromichi Hiraki (Kanazawa Univ., Japan), Sadao Oneda, and Hiroomi Umezawa. Progr. Theoret. Phys. (Kyoto), 27: 225-6(Jan. 1962). (In English)

The existence of the scalar K^* is not compatible with the partially-conserved-current hypothesis of weak interactions. The situation differs when the K^* is of the vector type (P-wave K-π resonance) and the inconsistencies discussed are not encountered; existence of the vector K^* is indicated. (L.N.N.)

17049 A NOTE ON A REMARK OF MINAMI'S. J. S. Dowker (Univ. of Pennsylvania, Philadelphia). Progr. Theoret. Phys. (Kyoto), 27: 226-8(Jan. 1962). (In English)

Effects of K^* on K^--π scattering were considered by calculating the K^* pole contribution; a modified propagator was proposed (S. Minami, Prog. Theor. Phys., 26: 356 (1961)). This concept is shown to be superfluous; the case of a scalar, spin zero K^* is considered. (L.N.N.)

17050 ELASTIC SCATTERING OF 2.8 Bev PROTONS ON PROTONS. S. A. Azimov, Ying-seb To, L. F. Kirillova, E. M. Khabibullina, E. N. Tsyganov, M. G. Shafranova, B. A. Shakbazyan, and A. A. Yuldashev (Joint Inst. for Nuclear Research, Dubna SSR and Inst. of Physics and Tech., Academy of Sciences, Uzbek SSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 430-4(Feb. 1962). (In Russian)

Elastic scattering of 2.8-Bev protons on protons was investigated with the aid of photographic emulsions. Altogether 492 elastic scattering events were found. The differential cross section for elastic proton-proton scattering through angles from 2.5 to 20.5° in the cms is derived. The experimental data are not in agreement with the assumption of a small spin interaction and real part of the phase shifts. The mean square proton-proton interaction range is found to be 1.06 ± 0.10 f. (auth)

17051 PRODUCTION OF HYPERONS IN LEAD BY K_2^0 MESONS WITH A MEAN ENERGY OF ~100 Mev. D. V. Nyagu, E. O. Okonov, N. I. Petrov, A. M. Rozanova, and V. A. Rusakov (Joint Inst. for Nuclear Research, Dubna, SSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 435-8(Feb. 1962). (In Russian)

Hyperon production on lead nuclei under the action of K_2^0 mesons with a mean energy ~100 Mev was investigated with a cloud chamber in a magnetic field. The production cross section for $\Lambda^0(\Sigma^0)$ hyperons on lead is estimated to be $\sigma(\Lambda^0 + \Sigma^0) = 200 \pm 70$ mb. The ratio of the cross sections for regeneration $K_2^0 \rightarrow K_1^0$ and creation of hyperons is markedly less than unity ($\sim 5 \times 10^{-2}$). (auth)

17052 ON A PHENOMENOLOGICAL DESCRIPTION OF PION–PION INTERACTION. L. D. Solov'ev and Tsung-mo Ch'en (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 526-37(Feb. 1962). (In Russian)

The relation between various low-energy processes is established by assuming that resonances exist for two pions with isotopic spin 1 in the P-state and for three pions with isotopic spin 0 in the P-state. The nucleon form factors, elastic pion–nucleon scattering, pion–pion scattering in the S-state, pion form factors, photoproduction, and inelastic scattering of pions on nucleons are also considered. (auth)

17053 BEHAVIOR OF THE AMPLITUDE FOR ELASTIC HIGH ENERGY PION–PION SCATTERING. G. Domokos (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 538-42(Feb. 1962). (In Russian)

The imaginary part of the elastic scattering amplitude of neutral, pseudoscalar particles is calculated in the limit of high energies for small momentum transfers. The resulting expression yields a constant cross section for high energies. The momentum transfer distribution possesses a diffractional peak in the forward direction. The shape of the latter is independent of the energy. (auth)

17054 SOME RESONANCE SOLUTIONS OF THE EQUATIONS FOR LOW ENERGY PION–PION SCATTERING. V. V. Serebryakov and D. V. Shirkov (Inst. of Mathematics, Siberian Branch, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 610-21(Feb. 1962). (In Russian)

A method is suggested for setting up limiting (for $\lambda \rightarrow 0$) resonance solutions of pion–pion scattering with power asymptotic expressions. Extension to the range of nonvanishing λ is carried out by the N/D-technique, a second subtraction being performed for function D. The three-parameter branch of solutions with one resonance in each of the waves with identical peak positions was investigated by this method. A feature of the power resonance solutions is the narrowness of the p-resonance for reasonable values of the S-wave scattering lengths and the broad resonance in the A_0-wave. The power branches are shown to be limiting cases of logarithmic branches corresponding to shifting of zeros (of the CDD type) to infinity. It is shown that the experimental value of the p-resonance width can be a criterion of the role of high energy contributions in the low energy region. (auth)

17055 ON INTERFERENCE BETWEEN THE AMPLITUDES OF INELASTIC PROCESSES. I. I. Roizen and D. S. Chernavskii (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 42: 625-9(Feb. 1962). (In Russian)

Interference between one-meson and two-meson amplitudes of high energy inelastic processes is considered. The magnitude of the interference terms depends on the nature of the elastic nucleon interaction. It is shown that if elastic scattering is of a diffractional nature, the above mentioned interference does not appear. (auth)

17056 FURTHER SEARCHES FOR THE DECAY $\mu \rightarrow e + \gamma$. A. I. Alikhanov, A. I. Babaev, M. Ya. Balats, V. S. Kaftanov, L. G. Landsberg, V. A. Lyubimov, and Yu. V. Obukhov (Inst. for Experimental and Theoretical Physics, USSR). Zhur. Ekspti'. i Teoret. Fiz., 42: 630-1(Feb. 1962). (In Russian)

The decay of a muon into an electron and a gamma ray was investigated with the aid of a spark chamber and fast electronics. The muons were created by a beam of 70-Mev π^+ mesons; the beam intensity was 2300 mesons per second. The efficiency for the registration of 53-Mev electrons, resulting from the sought decay mode, was 40%. The efficiency for the detection of gamma quanta of 53 Mev was 15%. The over-all efficiency of the experimental set-up for the detection of $\mu \rightarrow e + \gamma$ occurrences, bearing in mind the applicable criteria, was 0.8%. During 66 hr of running time 5.5×10^8 π^+ mesons were registered. In that time six electron–gamma occurrences were obtained with angles between the e and γ quanta ranging from 174 to 144° in the first projection (the direction perpendicular to the beam) and from 180 to 140° in the second projection (the depth camera). From the measurements it is concluded that the ratio of the decay sought for to that of the ordinary muon decay is 5×10^{-7}. (TTT)

17057 EXPERIMENTAL DETERMINATION OF THE PROBABILITY FOR THE β-DECAY OF THE π^+-MESON. A. F. Dunaitsev, V. I. Petrukhin, Yu. D. Prokoshkin, and V. I. Rykalin (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 632-5(Feb. 1962). (In Russian)

The following decay of the positive pion was sought: $\pi^+ \rightarrow \pi^0 + e^+ + \gamma$. This decay is analogous to the usual beta decay of the nucleon. The meson beam was stopped and registered in a scintillation counter, while the gamma quanta resulting from the π^0 decay were detected in two Cherenkov spectrometers set at 180° to one another. Over a period of about 30 hr approximately 1.4×10^9 π^+ mesons were registered. During that time one event was recorded. This event could be assigned either to the pion decay sought for, or to the charge exchange of the π^+ meson in the scintillator, an occurrence that could also result in a neutral pion. From this result an upper limit was set, $\lambda < 7 \times 10^{-8}$, where λ is the ratio of the probability for the beta decay of the pion to the probability for the ordinary decay of the pion into a muon. It is also found that the weak vector coupling constant, G, for the beta decay of the pion is less than 2.5 G_β, where G_β is equal to 1.4×10^{-49} erg cm^3 as determined from the beta decay of O^{14}. (TTT)

Neutron Physics

17058 (NYO-7877(Rev.1)) SUMMARY OF NEUTRON MEASUREMENT METHODS. Technical Memorandum No. 35(Rev.1). Herman L. Miller (Princeton Univ., N. J. Plasma Physics Lab.). Oct. 1956, Revised Feb. 12, 1962. Contract AT(30-1)-1238. 21p.

Practical methods of measuring a neutron flux are summarized. The problems of the efficiency of measuring apparatus and keeping the counter insensitive to gamma rays are described. Proton recoil methods, nuclear reactions, moderation, electronic equipment, and time-of-flight measurements are discussed. (M.C.G.)

17059 PROTECTIVE PROPERTIES OF WATER, POLYETHYLENE, AND PLEXIGLASS. D. L. Broder, A. A. Kutuzov, and V. V. Levin. Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 5: No. 2, 47-51(Feb. 1962). (In Russian)

Space distribution of fast neutrons in hydrogen and water is calculated. A removal cross section for oxygen and carbon in a wide range of energies is determined. (auth)

17060 ENERGY SPECTRUM OF Be(α,n) NEUTRON SOURCES. László Medveczky. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 3: 133-57(1961). (In Hungarian)

Following a summary of data on the fast neutron energy spectrum from Be(α,n) sources, results from measurements on two commercial Po–Be sources and a Ra–Be source are discussed. In the Po–Be spectra, the sites and number of the maxima are in good agreement. The significant peaks occur at 3.1, 4.2, 4.8, 6.4, 7.4, and 9.4 Mev. The energy spectrum of the Ra–Be source also is continuous, with an intensity peak between 1 and 6 Mev and an upper limit of 11.5 Mev. The average energy value is 4.6 Mev. The investigations do not support Hess and De Pangher's calculations. (auth)

Nuclear Properties and Reactions

Refer also to abstracts 16041, 16059, 16060, and 16061.

17061 (AROD-431:45) ELEMENTARY EXCITATIONS IN LIQUID HELIUM. Technical Report No. 29. Allen Miller, David Pines (Illinois. Univ., Urbana), and Philippe Nozières (Paris. Université). Mar. 1962. Contract DA-11-022-ORD-1001. 52p.

An analysis of some recent experimental and theoretical investigations of the elementary excitation spectrum of liquid He-II was carried out. The spectrum of density fluctuations, which was measured in an inelastic neutron scattering experiment, is shown to consist of two distinct parts: direct excitation of single quasi-particles from the condensed zero-momentum state; and excitation of more complex configurations arising from the interaction of two, three, or more quasi-particles. With the aid of general sum-rule arguments it is demonstrated that: (1) in the long wavelength limit, a single quasi-particle excitation exhausts the f-sum rule; the resulting excitation spectrum is identical to the phonon spectrum proposed by Feynman and found experimentally by Henshaw and Woods; (2) this asymptotic behavior of the density fluctuation spectrum may be used to normalize the experimental results of Henshaw and Woods to obtain a somewhat altered liquid structure factor curve, detailed information on the efficiency of quasi-particle excitation from the condensed state of an incident slow neutron, and an estimate of the depletion of the zero-momentum state as a consequence of particle interaction; (3) the backflow introduced by Feynman and Cohen corresponds to taking into account the coupling between a Feynman excitation and higher configurations involving several elementary excitations. The physical picture of backflow is clarified by means of a study of impurity atom motion in an interacting boson system. It is shown that in the Bogoliubov approximation the backflow around the impurity atom corresponds to a cloud of moving virtual phonon excitations which act to increase the impurity effective mass as well as to conserve current in the system. The generalization of these results to higher-order approximations, and to the coupling between quasi-particles in liquid helium, is discussed. The importance of accounting properly for depletion effects in a microscopic theory is emphasized; it is shown that such effects are neglected in the microscopic calculations of the interacting boson excitation spectrum previously carried out, although they are of decisive importance in the determination of the density fluctuation excitation spectrum. (auth)

17062 (AROD-2543:6) THEORETICAL EVALUATION OF THE VARIANCE FOR THE TIME CORRELATION METHOD FOR INVESTIGATING TWO CONNECTED NUCLEAR TRANSFORMATIONS. Technical Report No. 4. W. O. Doggett, L. K. R. Han, and R. P. Kennel (North Carolina State Coll., Raleigh). Mar. 1962. 33p.

The average value, variance, and fractional standard deviation are theoretically evaluated for the statistical correlation method (V. I. Gold'anski and M. I. Podgoretski, Doklady Akad. Nauk S.S.S.R., 100: 237(1955)) for measuring half lives in the 10^{-4} to 10^{-1} second region of daughter activities that are in secular equilibrium with long-lived parent radioactivities or constant sources. The general expressions developed by an original method of analysis reduce to those presented by the former authors for the special case of "prompt" daughter decay. (auth)

17063 (CEA-2086) CONTRIBUTION A LA THÉORIE DE LA MATIÈRE NUCLÉAIRE A BASSE DENSITÉ. (A Contribution to the Theory of Nuclear Matter at Low Density). Madan Lal Mehta (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 130p.

Thesis submitted to Universite, Paris.

A combination of the variational method using special momentum-conserving canonical transformations and the method of resummation of the infinite series of dominating terms in the low-density limit is used to study a strongly interacting N particle system. Under the hypothesis that the excitation energy E_k is convex and everywhere positive after the special canonical transformation minimizing the average value of the energy has been performed, it is shown that the t-matrix obtained by the summation of the ascending ladders is free from all singularities. Some particular examples are studied in detail. (auth)

17064 (CNLM-3244) AN ANALYSIS OF INCONSISTENCIES IN REMOVAL CROSS SECTIONS OF CARBON AND OXYGEN. H. C. Woodsum and F. L. Ingenito (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Dec. 21, 1960. Contract [AT(11-1)-229]. 12p.

Some recent analysis of certain Lid Tank fast neutron dose rates measured in oil and water indicated that there are some basic inconsistencies with reported oxygen and carbon removal cross sections and the reported data. These inconsistencies may be explained in several ways: the reported carbon removal cross section is wrong; the reported oil composition is wrong; the reported oxygen removal cross section is wrong since it is based on an assumed rather than a measured oil composition; or some of the experimental data are wrong. It is not possible to determine which of the above is most likely on the basis of analysis alone but the possibilities are pointed out and, based on the assumption that all the experimental data are correct, it appears most likely that the oil composition assumed was in error. Based on a different assumed composition, the oxygen removal cross section is reduced from 0.92 to 0.62 barns. (auth)

17065 (CTSL-32) A PRELIMINARY EXPERIMENT ON THE PHOTOPRODUCTION OF ω^0 MESONS FROM HYDROGEN. H. Ruderman, R. Diebold, and C. Peck (California Inst. of Tech., Pasadena. Synchrotron Lab.). Mar. 13, 1962. Contract AT(11-1)-68. 8p.

An attempt was made to measure meson (ω^0) photoproduction from hydrogen. The counting rate of recoil protons from a liquid hydrogen target at fixed laboratory angle and momentum as a function of end-point energy of the bremsstrahlung beam from the Caltech electron synchrotron was investigated. The appearance of a step in the counting rate at the treshold energy for a particle of mass near 790 Mev superimposed on the continuous distribution of protons from single π^0 and multiple π production would be considered as evidence for the reaction $\gamma + p \rightarrow p + \omega^0$. The beam monitoring fluctuations were about 0.6%, and the high counting rate runs showed neither systematic changes nor fluctuations larger than expected statistically. A threshold energy of 1250 Mev for a mass 790 Mev particle produced at 120° in the center-of-mass system was expected. Results showed that the likelihood ratio for there being a step at 1240 Mev to there not being a step is 20 : 1. Although the data were by no means conclusive, if the minimum of chi-square at 1240 Mev indicated that a particle of mass 784 ± 9 Mev is photoproduced, then the cross section would be 0.37 ± 0.16 μb/sr. (M.C.G.)

17066 (IA-698) GAUGES, GROUPS AND AN INVARIANT THEORY OF THE STRONG INTERACTIONS. Yuval Ne'eman (Israel. Atomic Energy Commission, Tel-Aviv). Aug. 1961. 213p.

The present strong interactions formalism does not lend itself to invariant derivation. An alternative theory constructed from first principles is suggested. Such a theory can be derived from a local gage invariance postulate. The transformations should form a unitary Lie group, the interaction being mediated by a set of vector-mesons, transforming like the group generators. The general features of such theories are studied and through Cartan's classification classical and exceptional algebras are surveyed using physical criteria to test their possible utilization as gages. Specific criteria are also added for a strong-interactions gage. (auth)

17067 (JINR-D-857) HIGHEST PARTIAL WAVES IN THE LOW ENERGY APPROXIMATION. A. V. Efremov and D. V. Shirkov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 16p.

The highest partial waves are taken into account in the equations for the low-energy pion-pion scattering obtained by the differential method. It is shown that their influence is small. The procedure of the introduction of an infinite number of partial waves in the low-energy equations is considered and is shown to have no sense. (auth)

17068 (JINR-D-860) ON THE KEMMER SCALAR SYMMETRICAL MODEL. G. V. Efimov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 13p.

The Kemmer scalar symmetrical model is treated by application of the Lappo-Danilevsky's method and the renormalization principles developed for the problems of the field theory with a fixed nucleon. It was found that the renormalization coupling constant of the model has an upper limit, and the connection between the renormalized and unrenormalized interaction constants is finite within the limit of point interaction. (J.R.D.)

17069 (JINR-D-922) PROPERTIES OF ELASTIC SCATTERING AMPLITUDES OF PIONS AND NUCLEONS AT HIGH ENERGIES. S. Domokos (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 4p.

An analysis of computational techniques related to these properties is presented. (J.R.D.)

17070 (NDA-2093-7) STATISTICAL THEORY OF NEUTRON RADIATIVE ABSORPTION CROSS SECTION. M. H. Kalos (Nuclear Development Corp. of America, White Plains, N. Y.). May 1, 1958. For General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati. Contract [AT(30-1)-2303], Subcontract AT-70. 30p.

A theory of radiative capture is outlined, following the methods of the continuum model. Explicit formulas are given which account for competition by elastic scattering and for fluctuations in neutron widths as long as $\Gamma_{n,l+2} \ll \Gamma_{n,l}$. Calculations for Cu^{65} and In^{115} are in satisfactory agreement with experiment up to about 400 kev. Results for Au^{197} are systematically low; it is likely that both the parameters used in the theory and the experimental results are wrong. (auth)

17071 (NP-11564) ON THE THEORY OF (γ,d) REACTIONS. J. Kwiecinski (Polish Academy of Sciences. Inst. of Nuclear Physics, Krakow). Dec. 1961. 19p. (PAN-141)

Starting from the independent pair model for the nucleus it is shown that the main contribution to the (γ,d) reaction is given by a certain two-stage process. It is shown furthermore that this reaction strongly depends on the angular momentum of the pair involved in the process and some suggestions concerning the influence of this dependence on the angular and energy distributions are given. (auth)

17072 (PNE-113P) RESONANCE NEUTRON ACTIVATION MEASUREMENTS. Preliminary Report. M. Lindner (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 5, 1962. Contract [W-7405-Eng-48]. 31p. Project GNOME.

The objectives, background, and experimental apparatus used in the resonance neutron activation experiment are discussed. The measurements of neutron flux, wheel position and timing, and foil activation are described, and the preliminary results are presented in graphic form. (auth)

17073 (SUI-61-6) A GENERALIZED CLUSTER MODEL AND NUCLEAR TRANSMUTATION. Stanley Bashkin (Iowa. State Univ., Iowa City). [1961]. Contract [AT(11-1)-1050]. 8p.

In a model for analyzing nuclear reactions which assumes that a nuclear system is decomposed by the polarizing influence of a coulomb plus nuclear shock wave into certain sub-clusters, the entire emphasis is on the initial and final configurations. In the absence of any reference to the compound nucleus, it was found that resonant reactions can be treated precisely on the same basis as beta decay. Predictions can be made as to the spins, parities, and isotopic spins which can be excited in a given reaction as well as for the dependence of the clustering effects on the energy and charge of interacting systems. The following examples are discussed: lithium-induced reactions, violation of isotopic spin selection rules, deuteron-induced reactions, beta decay, He^3-induced reactions, and resonant and nonresonant reactions. (M.C.G.)

17074 (VDIT-50) CROSS SECTIONS FOR NEUTRON INELASTIC SCATTERING AND (n,2n) PROCESSES. A Review of Available Experimental and Theoretical Data. M. Leimdoerfer and E. Bock (Aktiebolaget Atomenergi, Stockholm). Feb. 1962. 226p. (RFA-74)

A survey of the present state of knowledge on (n,n′) and (n,2n) reactions is presented. Results are given in the form of a main index to references on all elements and several special indices to different theoretical approaches, such as the direct-interaction concept, the continuum model (including level density theories), the discrete-level statistical model (Hauser-Feshbach), with a subsection on the optical model. Four hundred and thirty four references accompanied with abstracts giving essential information pertaining to the field are included. The time up to January 1962 is covered. Subject and author indexes are included. (auth)

17075 THE TOTAL INTERNAL CONVERSION COEFFICIENT OF THE 279-kev TRANSITION FOLLOWING THE DECAY OF Hg^{203} AS MEASURED BY A NEW COINCIDENCE METHOD. J. G. V. Taylor (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 40: 383-92(Apr. 1962).

Using a new coincidence method, the total internal conversion coefficient for the 279-kev transition following the β decay of Hg^{203} was measured with a standard deviation of about 1%. The method, which employs a $4\pi\beta$-γ coincidence arrangement, is based on the differential absorption of β particles and conversion electrons in 4π geometry. For determining the absolute efficiencies of γ spectrometers or ion chambers, the method yields directly the number of γ quanta emitted per Hg^{203} disintegration, without requiring any knowledge of the K : L : M conversion ratios. Likely sources of systematic error were investigated and their effect is smaller than the quoted standard deviation. The value obtained is $\alpha = 0.2262 \pm 0.0019$ or $\gamma/\beta = 0.8115 \pm 0.0015$, agreeing with β spectrometer measurements of Nijgh, et al. Widely differing values of conversion coefficients for this transition were reported previously. If the $K/(L + M + N)$ conversion ratio of 2.60 ± 0.06 is combined with this total conversion coefficient, a value $\alpha_K = 0.1633 \pm 0.0017$ is obtained. (auth)

17076 THE REACTION $Si^{28}(n,\alpha)Mg^{25}$ AT 14.6 Mev. Georges Ambrosino, Daniel Blanc, Francis Cambou, Danielle Devillers, Henri Reme, and Gilbert Vedrenne (Centre de Physique Nucléaire, Faculte des Sciences, Toulouse, France and Institut National des Sciences et Techniques Nucléaires, Paris). Compt. rend., 254: 1029-31 (Feb. 5, 1962). (In French)

The reaction $Si^{28}(n,\alpha)Mg^{25}$ for 14.6-Mev neutrons was shown by the utilization of a p-n junction. The α peaks obtained correspond to different levels of Mg^{25} and are in good agreement with the theoretical values. (tr-auth)

17077 ČERENKOV RADIATION: ITS ORIGIN, PROPERTIES AND APPLICATIONS. J. V. Jelley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Contemporary Phys., 3: 45-57(Oct. 1961).

In this account of Cherenkov radiation, the optical analogue of the "supersonic bang," great emphasis is laid on the underlying physical principles of the effect. The historical introduction is followed by a qualitative account of the basic mechanism of the generation of light by the passage of fast charged particles through homogeneous transparent media. After a discussion of the relationship of Cherenkov radiation to other processes connected with the interaction of fast particles with matter, the practical applications of Cherenkov detectors and counters in the fields of cosmic-ray and high-energy physics are discussed. In conclusion, some interesting experiments carried out on light flashes from the night sky are described. (auth)

17078 STOPPING OF Cf^{252} FISSION FRAGMENTS IN EMULSION. Kenneth D. Sevier (Univ. of California, Berkeley). Nuclear Instr. & Methods, 14: 318-20(Jan. 1962). (UCRL-9822). (In English)

An investigation was carried out to locate the rest position of fission fragments from Cf^{252} in Ilford K5 emulsion with respect to the end of the fragment track. This was found to be 0.131 ± 0.053 μ before the end of the fragment track, showing no clear indication of an extended range due to an ionization defect. The mean range of the fission fragments was 13.64 ± 0.19 μ with a standard deviation of 1.61 μ. Cf^{252} was found to decay 97.33 ± 1.41% by α decay and 2.67 ± 0.17% by spontaneous fission. (auth)

17079 A THREE-BODY MODEL OF Li^6. P. H. Wackman and N. Austern (Univ. of Pittsburgh). Nuclear Phys., 30: 529-67(Mar. 1962). (In English)

Li^6 is analyzed as a three-particle system composed of the three structureless, distinguishable particles, neutron plus proton plus alpha particle. The Schroedinger equation for the three-body system is solved by the Rayleigh-Schroedinger variational technique, as in calculations for T. The particles interact through local, two-body, energy-independent, phenomenological potentials obtained from analysis of two-body elastic scattering data. The spectrum of the nucleon-alpha potential contains states which violate the Pauli principle. The nucleon-alpha potential can be used consistently in the three-body model of Li^6, provided the eigenfunctions corresponding to the spurious states of this potential are projected out of the three-body wave function. The spurious state parts of the three-body wave functions are important in determining the energy of the S states in Li^6, but not in the D states. The four lowest levels of Li^6 differ in J, so that the variational method is suitable for finding the level structure. The three-body wave functions are constructed primarily from a p^2 configuration, modified by configuration mixing introduced by the neutron-proton correlation. The ordering found for the isobaric spin singlet levels (J = 1, 2, 3) is correct, and their calculated energy separations compare accurately with measured separations. However, the isobaric spin triplet (J = 0) level lies below the J = 3 level. All levels are displaced upwards in energy, on an absolute scale, by about 3.5 Mev. The calculated energies are insensitive to the detailed forms of the two-body potentials. Wave functions of the levels differ, the system tending to stretch as it is excited. A large recoil kinetic energy of the alpha particle is identified; the enhancement of this term in the D states (J = 2, 3) is of the same order as the entire level splitting. The quadrupole moment, magnetic moment, and charge radius of the ground state all are computed and agree with experiment. Coulomb separations of the isobaric spin triplet (J = 0) level are computed and agree with experiment in ratio and absolute magnitude. (auth)

17080 SEARCH FOR PSEUDOSCALAR INTERACTION IN $\frac{1}{2}+ \rightarrow \frac{1}{2}-$ β-DECAY TRANSITIONS. II. ON THE CALCULATION OF THE LONGITUDINAL POLARIZATION OF β^--PARTICLES EMITTED IN $\frac{1}{2}+ \rightarrow \frac{1}{2}-$ TRANSITIONS AND THE RELATIVE CONTRIBUTION OF THE PSEUDOSCALAR INTERACTION. S. A. Cuperman (Weizmann Inst. of Science, Rehovoth, Israel). Nuclear Phys., 30: 568-78(Mar. 1962). (In English)

A relation between the longitudinal polarization of the β^- particles emitted in $\frac{1}{2}+ \rightarrow \frac{1}{2}-$ transitions and the relative contribution of the pseudoscalar interaction to β decay were obtained. Lepton conservation, time reversal invariance, $C_S = C_T = 0$, and the validity of the two-component neutrino theory with a left-handed neutrino were assumed. The nonrelativistic nuclear matrix elements as well as the relativistic ones were taken into account, and the importance of the latter is mentioned. The combinations of electron radial wave functions were calculated by considering the finite size of the nucleus and carried out using a surface as well as a uniform distributed nuclear charge. Considerations on the sensitivity of other $\Delta J = 0$ transitions to the detection of the pseudoscalar interaction are also made. (auth)

17081 RELATIVE PHASE OF THE M1 AND E2 RADIATIONS IN THE $2^+ \rightarrow 2^+$ TRANSITIONS IN EVEN NUCLEI. Taro Tamura and Hiroshi Yoshida (Tokyo Univ. of Education). Nuclear Phys., 30: 579-98(Mar. 1962). (In English)

The relative phase of the M1 and E2 radiations which are mixed in the electromagnetic transition between the first and the second excited 2^+ states in even nuclei lying in the vibrational and rotational regions is calculated theoretically. Models are chosen in which the states, due to quasi-particle excitation, are coupled to the originally pure collective states. The relative phase is primarily determined by the sign of the magnetic moments of the admixed quasi-particle states, and agreement with experiment is obtained in most cases. (auth)

17082 EXCITED STATES OF Tl-208 AND Po-212. G. Bertolini, F. Cappellani, G. Restelli, and A. Rota (EURATOM, Ispra, Italy). Nuclear Phys., 30: 599-612 (Mar. 1962). (In English)

The excited states of Tl^{208} and Po^{212} were investigated. Excited levels of 40, 328, 473, 493, and 619 kev in Tl^{208} were confirmed by alpha and gamma spectroscopy. Conversion coefficients of 288 and 328-kev gamma agree with the M1 assignment. No evidence of a 619-kev gamma was found. Excited states at 730, 1510, 1620, 1680, and 1800 kev in Po^{212} were confirmed. No evidence of a 2200 kev direct gamma transition was found, but a cascade 600 to 1600 kev is suggested. Long-range alpha intensities were evaluated by solid state detectors. (auth)

17083 THE NUCLEAR PHOTOEFFECT IN HOLMIUM AND ERBIUM. E. G. Fuller and Evans Hayward (National Bureau of Standards, Washington, D. C.). Nuclear Phys., 30: 613-35(Mar. 1962). (In English)

The photoneutron yield and photon scattering cross sections were measured in the giant resonance region for holmium and erbium. Both cross sections were found to be the same within the experimental uncertainties for the two target materials. The absorption cross section integrated to 23 Mev is 3.20 ± 0.48 Mev-barns. The intrinsic nuclear quadrupole moment determined from the giant resonance splitting is 7.6 ± 1.1 barns. The observed scattering cross sections were large compared to those calculated from the observed absorption cross section by the optical theorem and the dispersion relation. The additional contribution to the scattering cross sections results from the optical anisotropy of these nuclei and can be predicted quantitatively from the expression for the scattering by a three-dimensional classical oscillator. A justification for the classical formulation is given. The data also suggest that between 10 and 23 Mev, at least 80% of the integrated absorption cross section is associated with charge oscillations along the three spatially correlated nuclear axes. (auth)

17084 ISOSPIN CONSERVATION IN THE β-DECAY OF Sc^{44}, Zr^{95}, AND Nb^{95}. Lloyd G. Mann, Stewart D. Bloom, and Richard J. Nagle (Univ. of California, Livermore). Nuclear Phys., 30: 636-43(Mar. 1962). (UCRL-6534). (In English)

The angular correlation between β rays and circularly polarized γ rays was measured by rapid alternation in Sc^{44}, Zr^{95}, and Nb^{95}. The result for Sc^{44} indicates that the Fermi matrix element is very small or zero, within experimental error. This agrees with results for Sc^{46} and Ar^{41} (also by the method of rapid alternation), but disagrees with the measurement of Boehm and Wapstra. In Zr^{95}, agreement is obtained with the results of Appel and Schopper, but an interpretation eliminating the need for their conclusion that interference exists between the Gamow-Teller and Fermi transitions. The interpretation requires that at least one pertinent excited state in Nb^{95} has spin $^7/_2$ (preferably the 726-kev state). The agreement between theory and the measurement is close and requires almost no mixing in any of the radiations. Nb^{95} decays via a pure Gamow-Teller ($\Delta J = 1$) transition followed by an almost pure M1 radiative transition. No other alternative has any reasonable probability. The spin of the level at 762 kev in Mo^{95} is $^7/_2$, and the spins of Sc^{44} and the level at 1.16 Mev in Ca^{44} are 2. (auth)

17085 THE CIRCULAR POLARIZATION OF GAMMA-RAYS FOLLOWING THE BETA-DECAY OF Nb^{95}. H. Appel, R. Blatter, and H. Schopper (Universität, Mainz). Nuclear Phys., 30: 688-90(Mar. 1962). (In English)

The asymmetry coefficient for the beta-gamma circular polarization correlation of the Nb^{95} decay is $A = 0.49 \pm 0.08$. This value agrees with the spin sequence $^9/_2 \rightarrow {}^7/_2 \rightarrow {}^5/_2$ and an essentially pure M1 gamma-transition. (auth)

17086 NEW RELATIVE NUCLIDIC MASSES. L. A. Koenig (Max-Planck-Institut für Chemie, Mainz), J. H. E. Mattauch, and A. H. Wapstra. Nuclear Phys., 31: 1-17 (Mar. 1962). (In English)

Data and procedures used to compute relative nuclidic masses in addition to or in replacement of those given earlier (F. Everling, et. al., Nuclear Physics, 18: 529(1960)) are presented. The masses themselves are presented separately (L. A. Koenig, et. al., Nuclear Physics, 31: 18 (1962)). (auth)

17087 1961 NUCLIDIC MASS TABLE. L. A. Koenig (Max-Planck-Institut für Chemie, Mainz), J. H. E. Mattauch, and A. H. Wapstra. Nuclear Phys., 31: 18-42(Mar. 1962). (In English)

A complete mass table is given allowing for new experimental data. (auth)

17088 GAMMA RADIATION FROM THE BOMBARDMENT OF ^{16}O AND ^{19}F NUCLEI WITH 150 Mev PROTONS. K. J. Foley, G. L. Salmon, and A. B. Clegg (Clarendon Lab., Oxford). Nuclear Phys., 31: 43-52(Mar. 1962). (In English)

Measurements of gamma-radiation from bound excited states of residual nuclei from reactions induced in O^{16} and F^{19} nuclei by 150-Mev protons are presented with measurements of the radioactive nuclei produced in the bombardment of O^{16}. Results provide a measure of the parentage of the ground state of O^{16} from the O^{16}(p, pn) reaction. Observation of the small cross-section for the production of the first excited state of C^{12} in the O^{16}(p, pα) reaction provides support for the purity of the shell-model wave function of the ground state of O^{16}. Cross-sections for the F^{19}(p, pα)N^{15} and F^{19}(p, pt) reactions leading to excited states of the residual nuclei are small but finite. (auth)

17089 FORWARD ASYMMETRY OF THE PHOTONEUTRON ANGULAR DISTRIBUTION. O. Borello, F. Ferrero, R. Malvano, and A. Molinari (Università, Turin and Istituto di Fisica Nucleare, Turin). Nuclear Phys., 31: 53-64(Mar. 1962). (In English)

An analysis is made of data on the fast photoneutron angular distribution from Bi^{209}. An indication of a conspicuous forward asymmetry is found that cannot be explained on the basis of any available theory. Indications are given for an explanation of the asymmetric term. New data are given of the fast photoneutron angular distribution from Bi^{209}, obtained using the Al^{27}(n, α)Na^{24} reaction as a detector. (auth)

17090 THE $P^{31}(p,\gamma)S^{32}$ REACTION AT 355 keV AND 440 keV PROTON ENERGY. E. B. Nelson, R. R. Carlson, and L. D. Schlenker (State Univ. of Iowa, Iowa City). Nuclear Phys., 31: 65-77(Mar. 1962). (In English)

Gamma radiation produced in the $P^{31}(p,\gamma)S^{32}$ reaction was studied at the 355 and 440-kev resonances. The relative intensity of the gamma in the spectra and their constancy with the angle of observation indicate s-wave proton capture and spin 1+ for each resonant capture level. A study of the angular correlation between the components of the cascade radiation at the 440-kev resonance confirms the 1+ assignment to the capture state and determines a spin and parity of 1+ for the 4.46-Mev level of S^{32}. The E2/M1 intensity ratios were obtained for transitions in S^{32}. (auth)

17091 POLARIZATION OF NEUTRONS IN SCATTERING FROM LIGHT NUCLEI AND IN THE $Li^7(p,n)Be^7$ REACTION. A. J. Elwyn and R. O. Lane (Argonne National Lab., Ill.). Nuclear Phys., 31: 78-117(Mar. 1962). (In English)

The left-right asymmetries of polarized neutrons scattered from Li^6, Li^7, Be^9, B, C^{12}, O^{16}, and Mg were measured at 45 and 90° at 0.1 to 2.4 Mev. Polarized neutrons were obtained from the $Li^7(p,n)Be^7$ reaction at 51° (lab.). In energy intervals near certain resonances, Li^7, O^{16}, and Mg scatterers were used as analyzers to determine the polarization in the reaction. A clearly-defined peak in the polarization is observed near $E_p \approx 2.2$ Mev. Its width is about 0.15 Mev. These results are compared with measurements and with calculations based on level parameters in Be^8. Results for the $Li^7(p,n)Be^7$ reaction were combined with measurements at higher energies to obtain the polarization in the scattering from the nuclei investigated. Of interest are the large polarization observed in scattering from Mg, the persistence of the polarization at an almost constant value of 0.35 in the scattering from Li^7 (at 45°) up to 2.4 Mev, and the observation that the polarizations for the nuclei with spin (Li^6, Be, and B) are usually smaller than those for the zero-spin nuclei in the vicinity of resonances for the nuclei involved. Results for some nuclei are compared with calculations based on analyses in terms of level parameters. (auth)

17092 SOME ENERGY LEVELS OF F^{21} AND Na^{25}. S. Hinds, H. Marchant, and R. Middleton (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nuclear Phys., 31: 118-27(Mar. 1962). (In English)

The $F^{19}(t,p)F^{21}$ reaction was studied by magnetic analysis, and the excitation energies of 19 states were determined. The Q-value of the reaction was 6.219 ± 0.012 Mev, which is consistent with the F^{21} mass excess of -0.045 ± 0.012 Mev. Excitation energies of 26 states of Na^{25} were also measured using the $Na^{23}(t,p)Na^{25}$ and the $Mg^{26}(t,\alpha)Na^{25}$ reactions. The Q-value of the former reaction was 7.492 ± 0.012, and that of the latter was 5.664 ± 0.012 Mev. Both Q-values are consistent with a Na^{25} mass excess of -9.357 ± 0.008 Mev. (Mass excesses are referred to the C^{12} scale). (auth)

17093 THE DECAY OF Lu^{177} TO Hf^{177}. M. S. El-Nesr and E. Bashandy (Univ. of Uppsala). Nuclear Phys., 31: 128-38(Mar. 1962). (In English)

The beta-decay of Lu^{177} was investigated, and four beta-groups of maximum energies 496.8 ± 1.7, 385 ± 2, 249 ± 4, and 174 ± 3 kev were found. The relative intensities were 90 ± 4, 2.95 ± 0.05, 0.31 ± 0.06, and 6.72 ± 0.25%, respectively. Beta-gamma coincidences were recorded between the second beta branch and the 113-kev gamma ray and between the fourth beta branch and the 208-kev gamma ray, and the curie plots from the coincidence measurements showed maximum energies of 384 ± 2 and 175 ± 1.0 kev which agree with the results obtained from the gross spectrum. The coincidences found between the 250 kev and the beta background confirmed the existence of a new beta group with low intensity. The L-conversion coefficient of the 113-kev gamma transition was determined by the coincidence technique and the result was 1.102 ± 0.110. The mixing ratio δ^2 = E2/M1 of the 113-kev gamma-ray as determined from the measured L-conversion coefficient was 27.0 ± 2.7 using the theoretical conversion coefficients calculated by Rose and 17.0 ± 1.7 from that calculated by Sliv and Band. The first value of δ^2 agrees with the results obtained by angular correlation measurements. (auth)

17094 QUASI-FREE ELECTRON–PROTON SCATTERING. [PART] I. Gerhard Jacob and Th. A. J. Maris (Universidade do Rio Grande do Sul, Pôrto Alegre, Brazil). Nuclear Phys., 31: 139-51(Mar. 1962). (In English)

It is shown that, from angular and energy correlation measurements on electron-proton pairs emerging from the scattering of high-energy (300 to 1000-Mev) electrons on nuclei, information on the energy levels and structures of the upper and lower shells of light and medium nuclei could be obtained. A calculation in which the distortion of the outgoing proton wave is taken into account was performed for C^{12}. As compared to the result for zero distortion, the absolute magnitude of the correlation cross section is reduced, but the shape of its angular distribution is practically unchanged. Consequently the observed energy and angular correlations would immediately give both the binding energy and the momentum distribution of the nuclear proton in the shell model state out of which it was ejected. From an extrapolation to other nuclei of the calculated value of the reduction factor for the cross section, it is expected that this situation prevails at least up to nuclei with A = 50. Corrections are qualitatively discussed. (auth)

17095 QUASI-FREE ELECTRON–PROTON SCATTERING. [PART] II. Gerhard Jacob and Th. A. J. Maris (Universidade do Rio Grande do Sul, Pôrto Alegre, Brazil). Nuclear Phys., 31: 152-6(Mar. 1962). (In English)

A distorted wave calculation for quasi-free electron-proton scattering on Ca^{40} was performed, and the results are discussed (G. Jacob and J. Maris, Nuclear Phys., 31: 139(1962)). (auth)

17096 MONO-ENERGETIC POSITIONS IN Bi^{205}. C. F. Perdrisat, H. J. Leisi, and J. H. Brunner (Federal Institut of Tech., Zurich). Nuclear Phys., 31: 157-9(Mar. 1962). (In English)

The K-positron line of the 1863-kev El-transition in Pb^{205} was measured, the rms error of the line intensity being 30%. The branching ratio for this process is 2.7 × 10^{-6} positron per gamma transition. If the Stockendal decay scheme is assumed, the mean life of the 2566-kev level is: $\tau = 1.8 \times 10^{-16}$ sec. An upper limit for the K-positron line of the 1906-kev El-transition less than 1.2 × 10^{-5} positron per gamma transition. (auth)

17097 MONO-ENERGETIC POSITIONS IN Eu^{152}. C. F. Perdrisat, H. J. Leisi, J. H. Brunner, and L. Piaggio (Federal Institut of Tech., Zurich). Nuclear Phys., 31: 160-2 (Mar. 1962). (In English)

A search of mono-energetic K-positrons of the 1409-kev transition in Sm^{152} was made. A ratio of (1.1 ± 0.5) × 10^{-7} positron per gamma ray was found. From an upper limit of 2.10^{-7} positrons per gamma ray, it is concluded that the mean life of the initial level at 1531 kev is $\geqq 0.7 \times 10^{-14}$ sec. (auth)

17098 MONO-ENERGETIC POSITON FORMATION COEFFICIENT IN THE CASE OF E1 TRANSITIONS. R. Lombard and F. Rys (Federal Institute of Tech., Zurich). Nuclear Phys., 31: 163-5(Mar. 1962). (In English)

The coefficient for mono-energetic positron formation for the K-shell is given as a function of energy for an E1-transition and Z = 82, 63, and 30. The numerical results differ from those of Sliv (L. A. Sliv, JETP (USSR), 25: 7 (1953)). (auth)

17099 THE DISINTEGRATION OF NEON AND KRYPTON BY NEUTRONS. R. E. Shamu (Univ. of Wisconsin, Madison). Nuclear Phys., 31: 166-76(Mar. 1962). (In English)

A high-pressure gas scintillation counter filled with neon or krypton was used to study disintegration cross sections for neutron bombardment. For neon, cross sections were measured at 6.2 to 10.7 Mev neutron energy with a neutron energy spread of about 60 kev. Partial cross sections were determined for which the residual nucleus of the reaction $Ne^{20}(n,\alpha)O^{17}$ was left in either its ground state or one of its first three excited states. For krypton, the cross section for disintegration by charged-particle emission was measured at 6.4 to 12 Mev neutron energy with a neutron energy spread of about 150 kev. Considerations based on reaction energetics and on the penetrability of the Coulomb barrier suggest that most of the observed krypton disintegrations correspond to (n,p) reactions. (auth)

17100 CONVERSION COEFFICIENT MEASUREMENT OF THE 426 kev PURE E2 TRANSITION IN Hg^{198}. E. Bashandy and M. S. El-Nesr (Univ. of Uppsala). Nuclear Phys., 31: 177-84(Mar. 1962). (In English)

The K-conversion coefficient of the 426-kev transition in Hg^{198} was measured using the electron-gamma coincidence method. The result obtained for $\alpha_K(426) = 0.0268 \pm 0.0028$ agrees with theoretical values for pure E2 transition. (auth)

17101 CONSEQUENCES OF THE CHANNEL COUPLING IN THE SCATTERING OF NUCLEONS BY NUCLEI. Sueji Okai (Tokyo Univ.) and Taro Tamura. Nuclear Phys., 31: 185-210(Mar. 1962). (In English)

Cross sections are calculated for the scattering of nucleons by nuclei, where the channel coupling is thought to play an important role. With the purpose of obtaining information about the consequences of the channel coupling, the calculations are performed with different choices of the parametric values, using a simplified model. The channel coupling theory reproduces the general qualitative features of the experiments, although detailed comparison with the experimental data can not be made. The calculation seems to furnish knowledge which will be useful for more realistic calculations. (auth)

17102 TIME-DEPENDENT HARTREE-FOCK EQUATIONS AND ROTATIONAL STATES OF NUCLEI. D. J. Thouless and J. G. Valatin (Univ. of Birmingham, Eng.). Nuclear Phys., 31: 211-30(Mar. 1962). (In English)

The connection between translational and rotational degeneracies in the solutions of the time independent Hartree-Fock equations and the existence of solutions of the time-dependent equations which represent uniform translational or rotational motions is investigated. With a non-spherical equilibrium shape, the equations give rotating solutions in which the self-consistent rotating potentials are determined by the motion of the particles. With no axial symmetry, and neglecting higher order effects in the angular velocities, there are time-dependent solutions corresponding to the general motion of a classical top. For an equilibrium shape with axial symmetry, the only rotational motions are uniform rotations about an axis perpendicular to the symmetry axis. The equations are studied in the density matrix formulation in which the results can be immediately extended to include the effect of pairing correlations. Solutions representing a uniform translational motion can be explicitly constructed. For the rotational motion, the changes in the density matrix are determined for small angular velocities by a linear equation. This contains a correction to the cranking model equation which expresses the effect of a transformation to a moving frame of reference on the velocity-dependent self-consistent potentials. The connection between vibrational and rotational solutions of the time-dependent Hartree-Fock equations is discussed. The rotational modes are related to zero-frequency solutions of the equations for small oscillations, and in the linear space of small variations the infinitesimal rotational and translational changes define an independent subspace. This leads to a separation of the rotational and translational energies in the Hamiltonian of the random phase approximation. (auth)

17103 GAMMA RADIATIONS FROM THE PROTON CAPTURE OF Mg^{25}. Dean R. Neher, F. W. Prosser, Jr., and R. W. Krone (Univ. of Kansas, Lawrence). Nuclear Phys., 31: 231-9(Mar. 1962). (In English)

The γ spectra from the $Mg^{25}(p,\gamma)Al^{26}$ reaction were observed at 0.950 to 1.80 Mev. The decays were examined for 20 resonances using large scintillation detectors and coincidence techniques. Cascades through intermediate levels in Al^{26} were observed. Relative intensities were measured for all the γ rays and consistent decay schemes proposed. (auth)

17104 REACTION CROSS SECTIONS AND THE SHAPE OF THE IMAGINARY PART OF THE OPTICAL POTENTIAL. A. R. Bodmer and J. R. Rook (Univ. of Manchester, Eng.). Nuclear Phys., 31: 240-50(Mar. 1962). (In English)

The dependence of the neutron and proton reaction cross sections on the shape of the imaginary part of the optical potential was investigated for energies less than about 10 Mev to determine the extent to which different shapes could be discriminated from a knowledge of reaction cross sections. At incident energies (typified by 4 Mev) for which the absorption is moderately strong, little information can be obtained about the shape, unless this is extreme, from either the neutron or proton reaction cross sections separately, and little more if these are considered together. At higher energies (typified by 8 Mev) for which the absorption is strong, information could be obtained about the surface region of the imaginary part of the potential insofar as some effective extension of this is concerned. (auth)

17105 THE β-SPECTRUM OF RaE. H. Daniel (Max-Planck-Institut für Kernphysik, Heidelberg). Nuclear Phys., 31: 293-307(Mar. 1962). (In German)

The β spectrum of RaE(Bi^{210}) was measured using an iron-free magnetic lens β spectrometer. A mixed ThB(Pb^{212})-RaE source was used. Calibration was made with the ThB conversion lines while the RaE β spectrum was taken after the decay of the ThB activity. The measured RaE β spectrum was analyzed using the theory of effective nuclear radii of Fujita, et al. Least square fits were performed, all nuclear matrix elements and the term containing the phase angle θ between vector and axial vector coupling constants being treated as free parameters. With the assumption of a pure VA interaction the angle θ was $|\theta - 180°| = (4.5 \pm 1.0)°$, and with the assumption of a STPVA interaction without Fierz interference, $|\theta - 180°| = (4.7^{-4.7}_{+2.1})°$. The stated errors are standard deviations only. Results agree with time reversal invariance. The parameters X, Y, and $\alpha Z/2\rho_1(\sigma \times r)$ were 25.2, −1.64, and 13.2, respectively. (auth)

17106 RATIO OF LONG TO SHORT RANGE FORCES IN FINITE NUCLEI. Sidney Kahana (Univ. of Copenhagen). Nuclear Phys., 31: 315-21(Mar. 1962). (In English)

An attempt is made to reconcile the preponderance of s-waves in the free-nucleon force with the observed ratio of field-producing forces to pairing forces in finite nuclei. It is shown that the pairing forces are weakened relative to the field producing forces by a repulsive momentum-dependent term in the nucleon-nucleon potential. The calculations are carried out in a j_n configuration, using a pseudo-potential to represent the nucleon force. (auth)

17107 INTERNAL BREMSSTRAHLUNG FROM P^{32} AND Y^{90}. M. A. Hakeem and Max Goodrich (Louisiana State Univ., Baton Rouge). Nuclear Phys., 31: 322-4(Mar. 1962). (In English)

The internal bremsstrahlung spectra of the allowed beta emitter P^{32} and the first forbidden beta emitter Y^{90} were studied using a scintillation spectrometer and compared with available calculations. The experimental spectrum of P^{32} does not agree exactly with the Knipp, et al., theory for allowed beta transitions. The deviations are not large but are significant and can be explained by the Coulomb corrections proposed by Lewis and Ford. The observed spectrum of Y^{90} disagrees with the extension of the Knipp, et al, theory for first forbidden beta transitions with tensor interactions. The Coulomb correction is inadequate to account for the deviation. The observed photon excess may be arising from detour transitions; an assumption supported by calculations of Lewis and Ford. (auth)

17108 EXPERIMENTAL EVIDENCE FOR A ONE PARAMETER DESCRIPTION OF COLLECTIVE SPECTRA OF DEFORMED EVEN NUCLEI. Raymond K. Sheline (Florida State Univ., Tallahassee). Nuclear Phys., 31: 335-7(Mar. 1962). (In English)

For even deformed nuclei over a wide region of A, a linear relationship is obtained between the product of the energy of the first excited state and A, and the parameter γ describing deviation from axial symmetry. (auth)

17109 GIANT RESONANCE OF DIPOLE ABSORPTION OF γ-QUANTA BY NON-SPHERICAL LIGHT NUCLEI AND SPECTROSCOPIC DATA ON EXCITED ONE-PARTICLE LEVELS. V. G. Neudachin and V. N. Orlin (Moscow State Univ.). Nuclear Phys., 31: 338-50(Mar. 1962). (In English)

The estimation of residual interactions by spectroscopic data on the lower states of nuclei determines, for average nuclei with $A < 70$, the position of a giant resonance in agreement with experiment, provided the calculations are based on shell theory. An analysis is performed for Li^7, C^{12}, and C^{13} as well as Mg^{24} and Mg^{25}. The hypothesis of Lane's weak coupling, manifestation of α-clustering in light nuclei, and possible non-sphericity of certain nuclei in the $1f_{7/2}$ shell are analyzed in connection with the discussion of spectroscopic data. (auth)

17110 THE DECAY OF $_{72}Hf^{173}$. J. Valentin, D. J. Horen, and J. M. Hollander (Univ. of California, Berkeley). Nuclear Phys., 31: 353-72(Apr. 1962). (UCRL-9731). (In English)

The energy levels of Lu^{173} were studied from the electron-capture decay of 24.0-hour Hf^{173}, using high-resolution permanent-field electron spectrographs with and without "pre-acceleration," a double-focusing spectrometer, scintillation spectrometers, and gamma-gamma coincidence techniques. Properties of the levels are discussed in terms of the unified model of Bohr and Mottelson and the single-particle model of Nilsson appropriate for spheroidally-deformed nuclei. The following intrinsic states are identified in Lu^{173}: $\frac{7}{2}$ + [404], ground; $\frac{1}{2}$ − [541], 128.2; $\frac{5}{2}$ + [402], 356.8; and $\frac{1}{2}$ + [411], 425.0 kev. The ground state of Hf^{173} has the configuration $\frac{1}{2}$ − [521]. The $\frac{1}{2}$ − [541] orbital of Lu^{173} originates from the $h_{9/2}$ proton state beyond the 82-proton shell and also in the fact of its high decoupling parameter (a = 4.2) which causes the I = $\frac{5}{2}$ rotational state to be found below the I = $\frac{1}{2}$ fundamental state. M1 and E2 relative transition probabilities within the $\frac{1}{2}$ − [541] band are discussed, and the theoretical parameter b_{M1}, upon which the M1 transition probability in a K = $\frac{1}{2}$ band depends, is estimated both from the experimental results and from the Nilsson wave-functions. Log ft values of the Hf^{173} decay are also discussed. (auth)

17111 ENERGY LEVELS OF Lu^{172}. J. Valentin, D. J. Horen, and J. M. Hollander (Univ. of California, Berkeley). Nuclear Phys., 31: 373-83(Apr. 1962). (UCRL-9780). (In English)

The energy levels of the odd nucleus Lu^{172} populated from the electron-capture of Hf^{172} were examined using high-resolution 180° spectrographs, a double-focusing spectrometer, and scintillation techniques. A new M3-isomer in Lu^{172} was found, with a half-life of 3.7 ± 0.5 min and energy at 41.9 kev. Alternative level schemes for Lu^{172} are presented and discussed in terms of expected configurations of the 71st proton and 101st neutron. (auth)

17112 THE HARMONIC OSCILLATOR AND SUPERMULTIPLET THEORY. I. THE SINGLE SHELL PICTURE. Marcos Moshinsky (Universidad de Mexico, [Mexico City]). Nuclear Phys., 31: 384-405(Apr. 1962). (In English)

A new approach is presented for the problem of n particles in a given shell of angular momentum l, interacting through two particle central potentials. In this approach a caricature of the problem is introduced in which the particles move in an harmonic oscillator potential of a 2l + 1 dimensional space and interact through operators associated with the infinitesimal transformations of the unitary group in 2l + 1 dimensions. The permutational and rotational symmetry of the original problem can be introduced directly in the caricature, and simplification can be achieved in determining energy levels. As an illustration of the method, an example of two-particle interactions is discussed. The analysis is self-contained and uses only elementary mathematical techniques. (auth)

17113 THE BRANCHING RATIO OF K CAPTURE TO POSITON EMISSION IN THE $2^- \rightarrow 2^+$ BETA TRANSITION IN ^{200}Tl AND THE K-CONVERSION COEFFICIENT OF THE 368 Kev E2 TRANSITION IN ^{200}Hg. B. Van Nooijen, H. Van Krugten, W. J. Wiesehahn, and A. H. Wapstra (Laboratorium voor Technische Fysika, Delft, Holland). Nuclear Phys., 31: 406-14(Apr. 1962). (In English)

The branching ratio of K-capture to position emission in the $2^- \rightarrow 2^+$ transition occurring in the decay of Tl^{200} was determined using beta-gamma coincidence measurements. The result $K/\beta^+ = 102 \pm 9$ deviates from the theoretical value for an allowed transition by a factor of 1.8. A measurement of the shape of the positon spectrum indicates that the difference cannot be explained by a large contribution of the $\Sigma|B_{ij}|^2(\Delta J = 2$, yes) matrix element. Using the beta-gamma coincidence results, a value $\alpha_K = 0.040 \pm 0.0025$ is derived for the K-conversion coefficient of the 368-kev E2 transition in Hg^{200}. Results agree with theoretical values given by Rose and by Sliv and Band. (auth)

17114 NUCLEAR INTERACTIONS AT 20 TO 150-Gev IN CARBON. Siddheshwar Lal, Yash Pal, and R. Raghavan (Tata Inst. of Fundamental Research, Bombay). Nuclear Phys., 31: 415-46(Apr. 1962). (In English)

Nuclear interactions produced in carbon by cosmic particles at 20 to 150 Bev are studied using a multiplate cloud chamber at 2210 m. At this altitude, the ratio of neutral to charged nuclear-active particles is 0.69 ± 0.13. The average charged multiplicity $\langle n_s \rangle$ for events with $n_s \geqq 3$ is 5.6 ± 0.2. Only (23 ± 4) % of the energy available in the c.m. system is used for production of π mesons. The energy spectrum in the laboratory system of the observed γ which result from π^0-decay is slightly steeper than that predicted by Heisenberg theory. The momentum spectrum of pions in the c.m. system is given by a varying power law. The average energy of a π meson in the c.m. system is 430 ± 50 Mev. The angular distribution of the created particles in the cms is isotropic. The average value of the transverse momentum of π mesons is 390 ± 25 Mev/c. The ratio of neutral π mesons to charged shower particles among the created particles is 0.4 ± 0.04 which, being the same as determined for interactions at energies ≈ 1000 Bev, indicates that among the created particles the fraction of charged particles which are not pions does not change significantly from 20 to 1000 Bev. The interaction indicates that the free path in brass for the charged secondary particles is 133 ± 14 g/cm². The ratio of secondary interactions induced by neutral to those induced by charged created particles in the brass plates of the chamber is 0.16 ± 0.07. (auth)

17115 ISOMERIC STATE IN Y^{86}. Y. E. Kim, D. J. Horen, and J. M. Hollander (Univ. of California, Berkeley). Nuclear Phys., 31: 447-51(Apr. 1962). (UCRL-9812). (In English)

A 48 ± 1-min isomeric level in Y^{86} was produced by irradiations of rubidium (natural and enriched in Rb^{85}) with alpha particles and of strontium (natural and enriched in Sr^{86}) with deuterons. Two transitions at 10.15 ± 0.1 and 208.0 ± 0.3 kev are observed in the decay of Y^{86m}. From the L sub-shell ratios, the multipolarity of the 10-kev transition is E3. The K-conversion coefficient of the 208-kev transition is $\epsilon_K = 0.04 \pm 0.01$. (auth)

17116 GAMMA-GAMMA DIRECTIONAL CORRELATIONS IN Pt^{192}. Lennart Simons, Erik Spring, and Gerhard Wendt (Univ. of Helsinki). Nuclear Phys., 31: 452-2 (Apr. 1962). (In English)

Measurements of gamma-gamma directional correlations were made of the 468-316, 300-300, 600-300, 588-613, 885-316, and 1065-316 kev cascades in Pt^{192} following the β decay of Ir^{192}. The first two cascades are composites of several cascades. The measurements, in combination with multipole measurements of gamma rays prove that the levels at 784, 921, and 1201 kev have spins and parities 4^+, 3^+, and 4^+, respectively. It is probable that the last two levels belong to a rotational band, the head of which is the γ-vibrational level with 2^+, K = 2, and energy 613 kev. For the 1381-kev level, 3^+, 3^-, or 4^- may be reported. (auth)

17117 FURTHER γ-SPECTROSCOPIC INVESTIGATIONS ON THE DECAY SCHEME OF I^{131}. D. Berényi, Gy. Máthé, and T. Scharbert (Inst. of Nuclear Research (ATOMKI), Hungarian Academy of Sciences, Debrecen). Nuclear Phys., 31: 456-9(Apr. 1962). (In English)

Problematic points in the decay scheme of I^{131} were studied using scintillation and coincidence techniques. The γ at 156 and 210 kev were spurious. The long known γ at 177 kev which does not fit into the decay scheme was in coincidence with a ray at 326 ± 10 kev. The intensity of this γ is ≈ 0.2 % in relation to the γ at 364 kev. From the level of 500 ± 10-kev energy corresponding to the sum of the two previous rays in cascade, a cross-over transition occurs also with a relative intensity of 0.8 ± 0.2%. It was found that in parallel with the direct transition of 364 kev only the cascade of 80 to 284 kev is present. (auth)

17118 THE ANGULAR CORRELATION OF SOME COINCIDENT GAMMA RAYS OF Pt^{194}. D. K. Butt and P. W. Nicholson (Univ. of London). Nuclear Phys., 31: 460-3 (Apr. 1962). (In English)

The angular correlation functions between the 1151, 939, 645, and 293-kev gamma and the 328-kev gamma ray of Pt^{194} agree with spins 0, 0, 2, 2, for the respective initial levels and an M1 admixture of < 1.0% in the 293-kev transition. (auth)

17119 NEUTRON ANGULAR DISTRIBUTIONS FROM THE REACTION $^{11}B(\alpha,n)^{14}N$. J. M. Calvert, N. H. Gale, J. B. Garg, and K. Ramavataram (Univ. of Manchester, Eng.). Nuclear Phys., 31: 471-7(Apr. 1962). (In English)

The neutron angular distributions from the reaction $B^{11}(\alpha,n)N^{14}$ are analyzed in terms of a combination of direct and heavy-particle stripping. Some of the data are equally well explained by compound nucleus formation. (auth)

17120 INFLUENCE OF THE INDISTINGUISHABILITY OF NUCLEONS ON NUCLEAR STRUCTURE. Karl Wildermuth (Florida State Univ., Tallahassee). Nuclear Phys., 31: 478-93(Apr. 1962). (In English)

It is shown that the indistinguishability of the nucleons is the reason the nuclear models do not contradict each other and the nuclear reactions and nuclear spectra present such different aspects. These considerations indicate a means for a unified description of nuclear phenomena. (auth)

17121 THE EFFECT OF THE PAULI EXCLUSION PRINCIPLE IN HIGH ENERGY NUCLEON–NUCLEUS SCATTERING. Paul A. Benioff (Universitet, Copenhagen). Nuclear Phys., 31: 494-506(Apr. 1962). (In English)

The effect of the antisymmetry of the nuclear wave function on high-energy nucleon-nucleus scattering is considered for finite nuclei. The effect is calculated as a correction to the optical potential and to the nucleon-nucleon cross sections inside the nucleus. In the high-energy limit, this correction is positive in contrast to the sign of the Pauli principle correction usually applied. This effect exists mainly in the nuclear interior and decreases rapidly in the surface due to its dependence on the square of the nuclear density. For a central potential in a shell model, there is no correction for $A \leqq 4$ nuclei. In the high-energy limit, the correction factors multiplying the free nucleon-nucleon cross sections in C^{12}, O^{16}, and Ca^{40} were 1.022, 1.029, and 1.046, respectively. The corrections 0.022, 0.029, and 0.046 are roughly $^1/_4$ to $^1/_2$ of the values predicted for a degenerate Fermi gas. (auth)

17122 NUCLEAR MATRIX ELEMENTS FOR ALLOWED l-FORBIDDEN TRANSITIONS. Marko Vakselj (Nuclear Institute "J. Stefan," Ljubljana, Yugoslavia). Nuclear Phys., 31: 525-8(Apr. 1962). (In English)

The relativistic shell model wave function can give the explanation for the anomalously long lifetime of l-forbidden beta transitions. In P^{32}, for example, the relativistic single-particle estimate gives log ft = 7.4 as compared to experimental value log ft = 7.8, and a few % deviations from the allowed shape. (auth)

17123 REABSORPTION OF FAST SECONDARIES IN NUCLEI. J. v[on] Behr and R. Hagedorn (CERN, Geneva). Nuovo cimento (10), 23: 339-54(Jan. 16, 1962). (In English)

The reabsorption of particles in the same nucleus where they were produced, is investigated. The model supposes incoherent interaction of the nucleons with the primary particle and with the secondaries and is limited to such high energies where this assumption holds good. An absorption coefficient is calculated, which relates the actual number of secondaries leaving the nucleus to the number of secondaries which would leave it if there were no reabsorption. This coefficient is a function of the atomic number, production and absorption cross-section per single nucleon, and angle of emission. This coefficient together with the total inelastic cross-section of the whole nucleus, which also is calculated as a function of the atomic number, yields all the relevant information. (auth)

17124 ON THE VALUE OF THE AXIAL VECTOR RENORMALIZATION IN β-DECAY. A. P. Balachandran (Univ. of Madras). Nuovo cimento (10), 23: 428-32(Jan. 16, 1962). (In English)

A model is presented in which the axial vector renormalization, $-G_A/G$, in β decay is calculable to all orders in the strong coupling constant provided that the strong interaction Lagrangian is γ_5-invariant. It turns out that $-G_A/G = -1$ which would imply that the unrenormalized β-decay interaction is V + A. (auth)

17125 GAMMA RAY SPECTROSCOPY OF ^{107}Cd, ^{109}Pd, AND ^{111}Pd. S. F. Eccles (Instituut voor Kernphysisch Onderzoek, Amsterdam). Physica, 28: 251-61(Mar. 1962). (In English)

Using scintillation techniques, gamma radiation following electron capture in Cd^{107} and beta decay of Pd^{109} and Pd^{111} was studied. Partial decay schemes of Ag^{107}, Ag^{109}, and Ag^{111} are suggested on the basis of experimental gamma energies and relative intensities plus an assumption of similarity in the low lying levels of these isotopes. (auth)

17126 THE INFLUENCE OF MAGIC NUMBERS ON THE SHAPE OF THE FISSION YIELD CURVE. A. H. W. Aten, Jr. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Physica, 28: 262-4(Mar. 1962). (In English)

The location of the transition between the valley and the heavy peak in the calculations presented is determined mainly by the magic number of 50 protons and not by that of 82 neutrons. The trend of the real values follows closely the trend of the values calculated for $Z = 50$, whereas the set of values calculated for $A - Z = 80$ shows a trend in the opposite direction. The conclusion that $Z = 50$ plays the principal role in determining the masses at which the transition between peak and valley occurs agrees with the fact that $A - Z = 82$ is often invoked to explain the fine structure of the high mass peak. This fine structure is different for different fissile nuclei, and $A - Z = 82$ cannot be used to explain the location of the slope. (L.N.N.)

17127 ATTEMPTS AT DERIVING NEW SYMMETRIES IN THE THEORY OF STRONG INTERACTIONS OF ELEMENTARY PARTICLES. Ryszard Rączka (Inst. of Nuclear Physics, Warsaw). Postępy Fiz., 12: 671-85(1961). (In Polish)

In the development of a Lagrangian for the interaction of baryons with K- and π-mesons, a Lagrangian that is invariant with respect to reflection, rotation and time-inversion, a form was obtained that has eight different coupling constants. The efforts directed at deriving new symmetries is related to the reduction of the number of coupling constants, since the reality of eight different coupling constants implies the existence of eight new physical constants. The derivation of a number of symmetries is reviewed, including those of Gell-Mann, Pais, Lichtenberg, Sakurai, and the formalism of Dallaporta. Although the latter formalism gives best agreement with experimental results, it has many important shortcomings. None of the theories take into account existing characteristics of elementary particles, such as the internal structure. The rapid accumulation of experimental data may play the important role in constructing a new, more perfect theory for strong interactions of elementary particles. (TTT)

17128 SOME RARE EARTH SPINS, AND THE HYPERFINE STRUCTURE OF ^{176}Lu. I. J. Spalding and K. F. Smith (Cavendish Lab., Cambridge, Eng.). Proc. Phys. Soc. (London), 79: 787-93(Apr. 1, 1962).

The nuclear spins of the isotopes Nd^{143}, Nd^{145}, Sm^{147}, Sm^{149}, Dy^{161}, Dy^{163}, Er^{167}, and Lu^{176} were measured by the atomic-beam magnetic-resonance technique. Earlier paramagnetic resonance results for the first seven isotopes were confirmed. The spin I of Lu^{176} was shown to be 7. The shell model accounts for the ground-state spins of the first four isotopes, and the collective model for those of the Dy, Er, and Lu isotopes. The hyperfine structure of Lu^{176} in the state $^2D_{3/2}$ was determined from $\Delta F = 0$ resonances and the following values of the dipole A and quadrupole B interaction constants give a good fit to the experimental data: A = (+)138.8 ± 1.0 Mc/s and B = (+)2151 ± 20 Mc/s. Unpublished measurements by Ritter of gI^{175}, $A(^2D_{3/2})$ and $A(^2D_{5/2})$ for Lu^{175} were used to estimate the magnitude of an s-electron configuration admixture to $A(^2D_{3/2})$ in Lu^{176}, and the following values of the Lu^{176} nuclear moments were then deduced $\mu^{176} = (+)3.07 \pm 0.28$ nm and $Q^{176} = (+)8.0 \pm 0.7$ b. The collective model with strong surface coupling predicts that $Q^{175}/Q^{176} = 0.697$ compared with the experimental ratio $B^{175}/B^{176} = 0.702$ (8), which is obtained by combining the results with those of Ritter. (auth)

17129 THE DE-EXCITATION OF THE 3 Mev DOUBLET IN ^{27}Al. B. T. Lawergren and T. R. Ophel (Australian National Univ., Canberra). Proc. Phys. Soc. (London), 79: 881-2(Apr. 1, 1962).

One of the levels of the 3 Mev doublet of aluminum-27 decays strongly by the emission of a (790 ± 30) kev gamma from the 2.209 Mev level. This mode of decay suggests that the 2.209 Mev level and one of the doublet states are the $(7/2)^+$ and $(9/2)^+$ members of a rotational band. A gamma-gamma coincidence measurement was made to establish the energy of the low energy gamma ray with greater precision and to verify that the cascade does not proceed by the 842 kev level. The 790 kev transition is found to occur between the higher energy member of the doublet at 3.000 Mev and the 2.209 Mev level. The 3.000 → 2.209 transition can be interpreted as an M1 transition between these high spin states. The 840 kev gamma ray can be attributed to the de-excitation of the 3.68 Mev level which is weakly excited at the bombarding energy used. (N.W.R.)

17130 ON THE DEUTERON ELASTICALLY SCATTERED BY NUCLEI. Yoshiyuki Sakamoto (Kyoto Univ.), Toshinori Takemiya, and Hiromi Tanaka. Progr. Theoret. Phys. (Kyoto), 27: 24-32(Jan. 1962). (In English)

The differential cross section and vector and tensor polarizations of high-energy deuterons elastically scattered by light nuclei are explained by the superposition of proton and neutron-nucleus interactions within the framework of the impulse approximation. The interaction between the proton and neutron in the deuteron is considered through the wave function of the deuteron. The calculated results for the differential cross section and the vector and tensor polarizations agree with experimental data except for (T_{20}). Cancellation of the matrix element in the vector and tensor polarizations of the deuteron, which does not occur in the differential cross section, are indicated. (auth)

17131 THE SEMI-CLASSICAL MODEL FOR THE NUCLEAR REACTIONS AT INTERMEDIATE ENERGIES. Mitsuji Kawai (Tokyo Inst. of Tech.). Progr. Theoret. Phys. (Kyoto), 27: 155-79(Jan. 1962). (In English)

A formalism is presented for the distorted wave approximation for the inelastic scattering of nucleons by nuclei at intermediate energies which lead to the continuous excited states of the residual nucleus. On the assumption of semi-classical approximation for the distorted waves of the incoming and outgoing particles, the Thomas-Fermi model for the nucleus, and the short range of the interaction, the cross section is obtained in a closed form as the sum of local collisions at all the points within the nucleus, which are given by the two nucleon cross sections averaged over the momentum distribution of the target nucleons multiplied by the penetrating and the escaping probability of the incident and the emitted particle, respectively. The localization of the collision is due to the average procedure over the final states of the nucleus. The semi-classical method of approximation for the distorted wave in the complex distorting potential is successfully performed by generalizing the "geometrical optics" approximation for a real distorting potential. The resulting expression permits a very simple, intuitive interpretation. Discussions on the validity of the approximations used in the derivation are given. (auth)

17132 REARRANGEMENT NUCLEAR REACTIONS AND OPTICAL MODEL. Mitsuo Sano (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 27: 180-202(Jan. 1962). (In English)

The formula for rearrangement nuclear reactions which describe both direct and compound processes from a unified point of view is derived in a manner simular to that for nucleon scattering by nuclei. The distortion of wave functions for a particle concerned in the rearrangement reaction is given by the optical potential determined from the elastic scattering of the particle by nuclei. The transition matrix element is written as a sum of two contributions, one from the direct process and the other from the compound process. If the energy of the incident particle is so high that the compound nucleus has closely spaced energy levels, the cross section should be averaged over a suitable energy interval. It is assumed that there is no coherence between the phases of the nearby compound nuclear levels, and the interference term between the direct and compound nucleus processes vanishes. The contribution of the compound nucleus reaction agrees with results described by the statistical theory. The formal theory of the rearrangement nuclear reaction is applied to the deuteron stripping reaction; the formula which gives the effective deuteron-nucleus interaction is derived. (auth)

17133 YIELD OF SPALLATION AND FISSION PRODUCTS IN HIGH ENERGY PARTICLE REACTIONS. A. N. Murin. Radiokhimiya, 4: 125-8(1961). (In Russian)

Comparisons of data from emulsion and radiochemical studies of uranium fission and spallation by high energy protons indicate a dependence of the product total cross sections on the magnitude of Z. Uranium reactions with 680-Mev protons are described by $\lg^{\sigma}_{total}(Z) = (\rho/S) Z +$ const, where $(\rho/S) = 0.30 \pm 0.03$. (R.V.J.)

17134 HEAVY IONS. G. Deconninck (Université, Louvain, Belg.). Rev. questions sci. (Belg.-France), 5-13 (Jan. 20, 1962). (In French)

An outline is given of the motivation for using heavy ion beams (Li, Be, B, etc.) in nuclear reaction studies. Experimental and theoretical aspects of reactions of heavy ions on medium and heavy nuclei are discussed. (T.F.H.)

17135 HYPERFINE STRUCTURE SPLITTING OF RECOILLESS γ LINES. III. THE 84-Kev LEVEL IN Yb^{170}. F. E. Wagner, F. W. Stanek, P. Kienle, and H. Eicher (Technische Hochschule, Munich). Z. Physik, 166: 1-5 (1962). (In German)

Nuclear resonance absorption was detected in the 84-kev level of Yb^{170} with the help of the Mossbauer effect. By measurement of the resonance absorption as a function of the Doppler displacement between a Tm^{170} metal source and a Yb_2O_3 absorber at 20°K, a hyperfine structure splitting of the 84-kev level was observed. The half life of the 84-kev level was measured at $1.5 \pm 0.2 \times 10^{-9}$ sec from a resolved resonance line. The splitting can be explained by a quadrupole interaction in the Yb_2O_3. (tr-auth)

17136 HYPERFINE STRUCTURE SPLITTING OF RECOILLESS γ LINES. IV. THE 80-Kev LEVEL OF Er^{166} IN Ho_2O_3 AND Er_2O_3. Friedrich W. Stanek (Technische Hochschule, Munich). Z. Physik, 166: 6-21(1962). (In German)

The nuclear resonance absorption of the Er^{166} γ radiation resulting from the decay of Ho^{166} was investigated. The transmission of the recoilless fraction was measured in an absorption experiment at 20°K in dependence on the relative velocity between source and absorber substance. The trivalent oxides Ho_2O_3 and Er_2O_3 were used as samples. The measured transmission spectrum showed significant minima with the width of the order of magnitude of the natural line width $2\Gamma = 4.8 \times 10^{-7}$ ev, corresponding to a lifetime of $\tau_N = 2.6 \times 10^{-9}$ sec. For the measurement of this hyperfine structure splitting, no exterior fields were applied. In order to understand the pattern and the magnitude of this splitting pattern, magnetic dipole and electric quadrupole interaction must be assumed. The magnetic interaction energy for the face-centered ions in the crystal lattice was measured at $W_{mag} = 5.3 \times 10^{-6}$ ev or 1400 MHz and the electric interaction energy at $W_{el} = 0.8 \times 10^{-6}$ ev or 210 MHz. From the total resonance absorption, the Debye temperature defined by the Debye-Waller factor was shown as 240°K. (tr-auth)

17137 NUCLEAR PHOTOEFFECT ON ALUMINUM AND FLUORINE WITH LITHIUM RESONANCE RADIATION. Eberhard Braun (Universität, Erlangen, Ger.). Z. Physik, 166: 62-75(1962). (In German)

Photoprotons were released from Al^{27} and F^{19} with the almost monochromatic γ radiation from the resonance reaction $Li^7(p,\gamma)$ at 440 kev. Their energy distribution was measured at the angles 30, 90, and 150° in nuclear trace photoplates. The proton spectra correspond largely with the prediction of the statistical theory; however, larger deviations occur at high proton energies (effect of the residual nucleus level at lower excitation). The angular distribution found is symmetrical at 90°; at higher proton energies deviations from isotropy is observed. Under consideration of known spins and parities, it was shown from the angular distribution that in the absorption of this γ energy an El and Ml interaction is present. (tr-auth)

17138 MÖSSBAUER EFFECT IN NORMAL-CONDUCTIVE AND SUPERCONDUCTIVE STATE OF Sn^{119}. W. H. Wiedemann, P. Kienle, and F. Pobell (Kommission für Tieftemperaturforschung der Bayerischen, Akademie der Wissenschaften, Munich and Technische Hochschule, Munich). Z. Physik, 166: 109-14(1962). (In German)

The number of Mössbauer quanta from the 23.8 kev state of Sn^{119} in a tin metal source was measured after attenuation by a 16.1 mg/cm^2 absorber of tin metal, as a function of temperature above and below the transition point of superconductivity. Source and absorber were kept at the same temperature. The data give evidence of a discontinuous change at the transition temperature. The transmitted intensity is lowered by $(1.3 \pm 0.15) \times 10^{-3}$ in the superconducting state of source and absorber. This corresponds to an increase of the Debye-Waller factor by about 0.4%. (auth)

17139 THE ENERGY AND ANGULAR DISTRIBUTIONS OF PROTONS FROM THE $Ca^{40}(\gamma,p)K^{39}$ REACTION WITH $E_{\gamma max} = 22$ Mev. T. N. Dragnev and B. P. Konstantinov (Inst. of Physics, Bulgarian Academy of Sciences, Sofia). Zhur. Ekspt'l. i Teoret. Fiz., 42: 344-8(Feb. 1962). (In Russian)

The energy and angular distributions of protons produced in the reaction $Ca^{40}(\gamma,p)K^{39}$ for $E_{\gamma max} = 22$ Mev are obtained. A fine structure is detected in the energy distribution. The experimental results are discussed on basis of Wilkinson's theory and the resonance theory of complex nuclei. (auth)

17140 GAMMA-RAYS PRODUCED IN INELASTIC SCATTERING OF 2.95 Mev NEUTRONS ON Ta^{181} NUCLEI. L. Ya. Graudynya, O. I. Kostochkin, K. A. Petrzhak, and A. V. Sorokina (Radium Inst., Academy of Sciences, USSR). Zhur Ekspt'l. i Teoret. Fiz., 42: 349-52(Feb. 1962). (In Russian)

The spectrum of γ rays excited during the inelastic scattering of neutrons with $E_n = 2.95$ Mev on Ta^{181} nuclei is obtained. (auth)

17141 INVESTIGATION OF THE ANGULAR DISTRIBUTIONS OF α-PARTICLES FROM THE $Li^7(p,\alpha)He^4$ REACTION. I. B. Teplov, I. S. Dmitriev, Ya. A. Teplova, and O. P. Shevchenko (Moscow State Univ.). Zhur. Ekspt'l. i Teoret. Fiz., 42: 353-7(Feb. 1962). (In Russian)

The angular distributions of α particles emitted in the $Li^7(p,\alpha)He^4$ reaction at angles between 20 and 160° are measured for energies of 5.78, 6.15, and 6.55 Mev. The excitation curve measured for proton energies from 3.3 to 6.6 Mev has a distinct resonance structure. An analysis of the results obtained is made. (auth)

17142 INVESTIGATION OF THE DEPENDENCE OF $\beta\gamma$-CORRELATION ON ELECTRON VELOCITY IN THE β-DECAY OF Co^{60} AND Au^{198}. V. M. Lobashov and V. A. Nazarenko (Leningrad Inst. of Physics and Tech.). Zhur. Ekspt'l. i Teoret. Fiz., 42: 358-63(Feb. 1962). (In Russian)

The dependence of the $\beta\gamma$ correlation coefficient on the electron v/c value is studied for circularly polarized γ quanta in Co^{60} and A^{198} β decays. It is shown that for Co^{60} and energies < 150 kev the correlation coefficient is slightly smaller than $-v/3c$. Within the experimental errors the coefficient for Au^{198} linearly depends on v/c. This is in accordance with the interpretation of Au^{198} β decay as Coulomb transition. (auth)

17143 DEVIATIONS FROM THE ALLOWED FORM OF THE P^{32} β-SPECTRUM. Ch'êng-jui Ch'ing and L. S. Novikov (Moscow State Univ.). Zhur. Ekspt'l. i Teoret. Fiz., 42: 364-9(Feb. 1962). (In Russian)

It is shown that deviations from the allowed form of the β spectrum can be satisfactorily described by a form factor which is equivalent to the Gell-Mann correction for the weak magnetism effect. The sign of the deviation is different from that indicated by Gell-Mann for the case of the electronic decay. (auth)

17144 $\beta\gamma$-CORRELATION IN β-DECAYS OF Mn^{56} AND F^{20}. V. M. Lobashov and V. A. Nazarenko (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 42: 370-4(Feb. 1962). (In Russian)

An anisotropy is found in the angular $\beta\gamma$ correlation for the allowed $Mn^{56} \rightarrow Fe^{56}$ transition. The anisotropy coefficient is $A_2 = +0.022 \pm 0.003$. The anisotropy of the angular $\beta\gamma$ correlation is compared with the energy dependence of $\beta\gamma$ correlation for circularly polarized γ quanta. It is shown that existing estimates of the second forbidden matrix elements can explain the observed anomalies. Measurement of the polarizational $\beta\gamma$ correlation in the β decay of F^{20} shows that a spin and parity 2^+ should be assigned to the ground state of F^{20}, the ratio of the transition matrix elements being $|M_F|/|M_{GT}| < 0.2$. (auth)

17145 INVESTIGATION OF RESONANCES AT E_p = 1375 AND 1500 kev IN THE $Si^{29}(p,\gamma)P^{30}$ REACTION. Yu. P. Antuf'ev, A. K. Val'ter, A. N. L'vov, E. G. Kopanets, and S. P. Tsytko (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 386-91(Feb. 1962). (In Russian)

The relative yield of γ rays from the $Si^{29}(p,\gamma)P^{30}$ reaction is measured in the proton energy range from 1.3 to 1.5 Mev. Five resonances have been detected of which two are studied in detail. From measurements of the γ-ray spectra and angular distributions the quantum characteristics of the P^{30} levels have been determined for exciting energies of 6.892 Mev, $J^\pi = 1^+$, $T = 0$ and 7.014 Mev, $J^\pi = 2^+$, $T = 0$. A scheme of γ transitions for two of the resonance levels of P^{30} is suggested and discussed. (auth)

17146 INELASTIC SCATTERING OF 6.6 Mev PROTONS ON Ca^{40} AND Mn^{55}. S. S. Vasil'ev, E. A. Romanovskii, and G. F. Timushev (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 395-402(Feb. 1962). (In Russian)

Inelastic scattering of 6.6-Mev protons leading to the excitation of the 3.352, 3.733, and 3.912 Mev levels in Ca^{40} and the 0.131, 1.291, 1.523, and 1.885 Mev levels in Mn^{55} is investigated. It is shown that direct processes play a large role in inelastic scattering of protons by these nuclei. The spins and parities of the lower levels of Ca^{40} are respectively 0^+, 3^-, and 2^+. There are indications that the 0.131, 0.984, 1.291, and 1.885 Mev levels in Mn^{55} are of a collective nature, the 1.523 level being a single-particle one. (auth)

17147 NEW SHORT-PERIOD ISOMERS Nd^{140m}, Pm^{144m}, Eu^{146m} AND Gd^{158m}. V. V. Remaev, V. T. Gritsyna, and A. P. Klyucharev (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 408-15(Feb. 1962). (In Russian)

Short-period γ radiation from PrO_4, Sm_2O_3, and Gd_2O_3 samples irradiated with 20.8-Mev protons was detected. The radiation is found to be due to decay of isomer states of nuclei produced in the nuclear reactions $Pr^{141}(p,2n)Nd^{140m}$, $Sm^{147}(p,2n)Eu^{146m}$, and $Gd^{160}(p,p2n)Gd^{158m}$. The isomer activity previously produced by irradiating a Nd_2O_3 sample with protons is identified. This short-lived γ-radiation is due to decay of the Pm^{141m} produced in the reaction $Nd^{142}(p,2n)Pm^{141m}$. (auth)

17148 INVESTIGATION OF SOME RADIOACTIVE NUCLEI IN THE REGION OF THE FILLED $1f_{7/2}$ SHELL. K. A. Baskova, S. S. Vasil'ev, Seng-ch'ang No, and L. Ya. Shavtvalov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 416-26(Feb. 1962). (In Russian)

The radiations from the radioactive nuclei Ni^{65}, Co^{55}, Mn^{51}, V^{47}, and Se^{83} are investigated with a magnetic β spectrometer with a thin lens and a scintillation γ spectrometer. Coincidence spectra between β particles and γ quanta with energies 1490 and 1120 kev are obtained for Ni^{65}. The separated partial β spectra possess end point energies, respectively at 620 and 1020 kev. The Co^{55} β^+ transition with an energy end point of 1500 kev takes place to an excited level with subsequent emission of 940 kev γ rays. For Co^{55} β^+ (1040 kev)$-\gamma$(1410 kev) coincidences were likewise observed. The Mn^{51} β spectrum consists of two components with end point energies at 600 and 2170 kev. Weak γ transitions with energies of 1560 and 2030 kev are observed. The V^{47} β^+ spectrum is simple with an end point energy at 1890 kev. Also 1800 and 2160 kev γ quanta are detected in V^{47}. Besides the previously known components a hard 3300 kev component with an intensity of the order of 2% is separated from the Se^{83} β^- spectrum. Also 220, 355, 1850, and 2300 kev γ transitions are observed in Se^{83}. The 530, 780, 1060, and 1300 kev γ transitions previously assigned to Se^{83} should be assigned to Br^{82}. Some of the low-lying excited states of odd nuclei containing 29 (or 27) protons or neutrons are classified. (auth)

17149 INVESTIGATION OF THE $He^4(\gamma,np)D^2$ PHOTONUCLEAR REACTION. T. I. Kopaleishvili and R. I. Dzhibuti (Inst. of Physics, Georgian SSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 467-70(Feb. 1962). (In Russian)

The $He^4(\gamma,np)D$ reaction is treated in the nucleon pair correlation model. The dependence of the total reaction cross section on photon energy and the distribution in relative neutron and proton energies are derived. A comparison with the experimental data is carried out. (auth)

17150 ON THE INTERACTION BETWEEN PROTONS AND NEUTRONS IN THE PAIR CORRELATION MODEL. B. L. Birbrair (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 42: 479-84(Feb. 1962). (In Russian)

Quadrupole excitations of even-even spherical nuclei are considered by taking into account the pn interaction. Formulas are derived for the energies of two spin 2^+ levels and also for the reduced probabilities of E2 transitions between them and to the ground state of the nucleus. (auth)

17151 EXCITATION OF COLLECTIVE NUCLEAR LEVELS IN HEAVY μ-MESIC ATOMS. D. F. Zaretskii and V. M. Novikov. Zhur. Eksptl'. i Teoret. Fiz., 42: 511-19(Feb. 1962). (In Russian)

Effects connected with quadrupole interaction of a muon with the nucleus in heavy mesic atoms are investigated. The probabilities of excitation of collective nuclear levels are computed. The hyperfine splitting of the collective nuclear level, additional muon depolarization, and change in circular polarization of the γ quantum from the 2p$-$1s transition are considered. (auth)

17152 SINGLE-PARTICLE LEVELS IN O^{17} AND F^{17} NUCLEI UNDER THE ASSUMPTION OF A STRONG COUPLING OF THE NUCLEON AND CORE WITH THE TETRAHEDRON SYMMETRY. S. Mattkhiz, V. G. Neudachin, and Yu. F. Smirnov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 592-6(Feb. 1962). (In Russian)

A method for calculating the single-particle states in the α-model is proposed which is based on the use of a nonspherical potential similar to the Nielsson potential but possessing different symmetry properties. The spectrum of low lying levels in the O^{17} and F^{17} nuclei are calculated by taking into account the interaction between the particle motion and rotation. The results are in satisfactory agreement with the experiments. (auth)

17153 OBSERVATION OF REACTIONS INVOLVING THE CAPTURE OF THREE NEUTRONS AND THE STRIPPING OF THREE PHOTONS IN THE INTERACTIONS OF N^{14} AND Ne^{20} IONS WITH C, Al, Cu, AND Ta NUCLEI. V. V. Volkov, L. Pomorski (Pomorskii), J. (Ya.) Tys, and G. N. Flerov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 635-7(Feb. 1962). (In Russian)

Thick targets of C, Al, Cu, and Ta were bombarded with N^{14} and Ne^{20} ions accelerated in the heavy ion cyclotron of the Joint Institute. The delayed neutron activity of N^{17} (4.15 sec) was then detected using BF_3 and a proportional counter. The N^{17} yield per incident particle was obtained as a function of bombarding energy. Smooth curves drawn through the experimental yield points were then differentiated and the cross section as a function of bombarding energy was obtained for the various reactions investigated. The cross sections at the full bombarding energy ranged from 0.03 to 8 mb. From the shapes of the excitation functions it is concluded that the N^{17} was produced from the transfer of three neutrons to the N^{14} beam particles and the transfer of three protons from the Ne^{20} nuclei to the target nuclei. (TTT)

17154 1960 NUCLEAR DATA TABLES. PART 4. SHORT TABLES. K. W. Ford, Gladys H. Fuller, A. M. Kaufman, L. J. Lidofsky, Jerry B. Marion, E. der Mateosian, M. McKeown, S. M. Shafroth, and K. Way, comps. (National Research Council. Nuclear Data Group). Dec. 1961. 254p. $1.50(GPO).

Tabulations are included on elastic and inelastic scattering of charged particles, distribution of charge in the nucleus, nuclear moments, total beta disintegration energies, and gamma rays emitted by radioactive nuclei. A supplement to Directory to Nuclear Data Tabulations, 1958-61, is also included. (D.E.B.)

17155 EINFLUSS DES PARAMAGNETISMUS AUF DIE RICHTUNGSKORRELATION (MESSUNG MAGNETISCHER KERNMOMENTE VON Dy^{160} UND Er^{166}) (PROMOTIONSARBEIT). (Influence of Paramagnetism on the Directional Correlation (Measurement of the Nuclear Magnetic Moment of Dy^{160} and Er^{166}) (thesis)). Walter Kuendig (Eidgenössische Technische Hochschule, Zürich). Basel, Buchdruckerei Birkhäuser AG., 1961. 40p.

Angular correlation investigations were undertaken in order to elucidate the influence of extranuclear fields. It is shown that for the γ-γ-cascades of Dy^{160} and Er^{166}, most of the observed attenuation effects can be explained by magnetic interaction of the electron shell with the magnetic dipole moment of the nucleus. A method for determination of nuclear moments in paramagnetic materials is described. Experimental results indicate that the magnetic field H_0 which influences the nuclear spin precession is the external field $H_{ext.}$ modified by a paramagnetic correction factor: $H_0 = H_{ext.}(1 + C'/(T - \Theta))$. The g-factors of the first rotational state of two even-even nuclei were measured; for Dy^{160}, $g_N = 0.46 \pm 0.05$ and for Er^{166}, $g_N = 0.36 \pm 0.06$. The γ-γ-angular correlation behavior on reversal of the magnetization of ferromagnetic Tb was investigated. Thence the mean life of the first vibrational state of its decay product, Dy^{160} was determined as $\tau_N = (1.1 \pm 0.4) \cdot 10^{-12}$ sec. (auth)

Particle Accelerators

17156 (AERE-T/M-126) RANDOM ERRORS AND MISALIGNMENTS IN THE A/G PROTON LINEAR ACCELERATOR. N. M. King (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). July 1955. 28p.

Expressions were derived for the effects of three types of random error in a root-mean-square linear accelerator. These are: misalignment of the zero-field (longitudinal) magnet axis; rotations of the transverse magnetic axes (twists); and errors in magnetic field magnitude. The first type was found to lead to "wander" of the entire proton beam around the design axis, while the other two result in radial expansion, or "blow-up" of the beam. The magnitude of these effects was estimated for different root-mean-square values of the errors. The results indicated that a 0.010-in. misalignment of the zero-field axes creates a maximum beam wander of 0.54 cm while a twist of 2° can cause a radial expansion of 0.04 cm. A 2.5% error in field magnitude led to a radial expansion of 0.17 cm. It is suggested that correcting lenses should be provided to overcome wander and re-center the beam. (auth)

17157 (PPAD-442D) THE MAGNET POWER SERVO SYSTEM FOR THE PRINCETON-PENNSYLVANIA PROTON SYNCHROTRON. S. Waaben (Princeton—Pennsylvania Accelerator, Princeton, N. J.). Feb. 20, 1962. Contract AT(30-1)-2137. 30p.

The magnet power regulation system for the Princeton-Pennsylvania 19c/s repetition rate 3-Bev Proton Synchrotron is described and analyzed. Rotating machinery is used for supplying the losses of the complex resonance system powering the magnets. The magnet field variation is a d-c biased sinewave having a minimum field of 250 gauss and a peak field of 13800 gauss. The fluctuations are controlled so as to be less than one gauss. (auth)

17158 (SCR-481) NEUTRON BACKGROUND IN THE BREMSSTRAHLUNG BEAM OF A 22-Mev BETATRON. R. I. Ewing (Sandia Corp., Albuquerque, N. Mex.); R. L. Bramblett (California. Univ., Berkeley. Lawrence Radiation Lab.); and T. W. Bonner (Rice Inst., Houston, Tex.). Feb. 1962. Contract [AT(29-1)-789]. 12p.

The most probable energy of the "background" neutrons produced principally in the lead collimation of a 22-Mev betatron during its operation was found to be 0.9 ± 0.1 Mev. Neutron detectors consisting of rhodium foils mounted inside paraffin spheres of various diameters were irradiated at a point 108 cm from the platinum electron target on the axis of the bremsstrahlung beam, and the activity of the 44-sec beta decay of Rh^{104}, which follows thermal neutron capture in Rh^{103}, was counted. A lead plug placed in the beam exit port reduced the bremsstrahlung intensity and increased the neutron intensity without appreciable distortion of the neutron spectrum. The detectors were calibrated using monenergetic neutrons produced with a van de Graaff accelerator. (auth)

17159 (UCRL-Trans-812) ION CAPTURE AND INITIAL ORBITS IN THE ISOCHRONOUS CYCLOTRON KARLSRUHE. Martin Reiser. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Nuclear Inst. & Methods, 13: 55-69(Aug. 1961). 30p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 3755.

17160 BEAM TRANSPORT FOR HIGH ENERGY PHYSICS. K. H. Reich. Kerntechnik, 4: 94-9(Mar. 1962). (In German)

Engineering tasks are described which arise in the design and construction of beam ejection schemes, targets, lenses, bending magnets, collimators, shielding blocks, and particle separators for high energy physics. (auth)

17161 MEASUREMENTS AND COMPUTATIONS FOR SOLVING THE PROBLEMS OF THE RADIATION PROTECTION OF ACCELERATORS. Ágnes Pázsit. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen), Közlemények, 3: 123-32(1961). (In Hungarian)

Calculation methods are reported for gamma and neutron shielding for accelerators. The computations were compared with results of others. The calculated shield thickness was 30 to 40% larger than the measured thickness. (auth)

17162 THE SCIENTIFIC APPLICATION OF PARTICLE ACCELERATORS TO NONDESTRUCTIVE TESTING. E. A. Burrill (High Voltage Engineering Corp., Burlington, Mass.). Materials Research & Standards, 2: No. 1, 9-16(Jan. 1962).

The basic characteristics of nuclear particles and radiation produced by accelerators in the energy range of 1 to 10 Mev are reviewed. Possible applications in nondestructive testing or allied fields are pointed out. The production, interaction, and detection of electrons, x rays, positive ions, and neutrons are described. Examples are given of the uses of these radiations in nondestructive testing. (M.C.G.)

17163 CONTROL OF THE RADIATION SURROUNDING THE SYNCHROTRON OF THE LABORATORI NAZIONALI DE FRASCATI. M. Ladu (CNEN, Frascati, Italy). Minerva nucleare, 5: 336-9(Dec. 1961). (In Italian)

The radiation control system, safety devices, and shielding applied near an electrosynchrotron are described. The results of measurements of the doses received by the personnel and of the environmental radioactivity are presented. (auth)

17164 ON THE FIELD ERRORS AT LOW MAGNETIC FIELD OF THE A. C. MAGNETS FOR A SYNCHROTRON. Hiroshi Sasaki (Tokyo Univ.). Nuclear Instr. & Methods, 14: 252-62(Jan. 1962). (In English)

The magnetic fields near the injection field of the synchrotron magnet were investigated with the peaking strips. The errors of the field at low magnetic field are introduced by the residual magnetism of the magnet. There was no evidence of the eddy current effect on the field errors. It was found that the field irregularities at low field were considerably affected by the mechanicals stress applied to the yoke. The azimuthal field bump was within ± 0.1 gauss rms, and the fluctuation of the field index at the central field of 50 gauss was ± 0.4% rms on the central electron orbit. (auth)

17165 THE CRITERIA AND TECHNIQUES OF MAGNETIC FIELD MEASUREMENT USED ON THE UCLA 50 Mev SPIRAL RIDGE CYCLOTRON. David J. Clark, J. Reginald Richardson, and Byron T. Wright (Univ. of California, Los Angeles). Nuclear Instr. & Methods, 14: 321-36(Jan. 1962). (In English)

The precision in the field measurements necessary for satisfactory operation of this cyclotron is calculated. The Hall plate detectors are described. The various methods of field measurement used to give the desired precision are presented. (auth)

17166 ELECTRONIC STABILIZATION OF THE COCKCROFT-WALTON GENERATOR OF THE "ECOLE ROYALE MILITAIRE," [BRUSSELS]. (SUMMARY). G. Dome and H. d'Hoop. Rev. H. F., 4: 215-20(1960). (In English)

The linear accelerator being constructed for the Ecole Royale Militaire uses a very high voltage generator of the Cockcroft-Walton type as injector. The electronic stabilization circuit of this generator is described. (auth)

17167 RESONANT DEPOLARIZATION OF A BEAM OF POLARIZED PROTONS DURING ACCELERATION IN A SYNCHROCYCLOTRON. F. Lobkowicz and E. H. Thorndike (Univ. of Rochester, N. Y.). Rev. Sci. Instr., 33: 454-5 (Apr. 1962). (NYO-10030)

The loss of initial polarization of a proton beam during acceleration in a synchrocyclotron is investigated. It is shown that, due to resonance effects, substantial depolarization occurs unless the field inhomogeneities are kept well below 0.01%. (auth)

17168 SINGLE CAVITY HIGH CURRENT ELECTRON ACCELERATOR. Douglas Venable (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr., 33: 456(Apr. 1962).

A single 50-Mc cavity electron accelerator is described. When operating in the TM$_{010}$ mode, it is capable of delivering a 29-amp, 0.2-μsec, 8-Mev, 2-cm radius beam to a target downstream from the cavity. When focused to a 3-mm-diam spot, the beam current is reduced to about 9 amp; the resulting radiation flux is about 1.2 r at one meter for a 0.2-μsec pulse length. (auth)

17169 STABLE ELECTRONIC INTEGRATOR SWITCH. Robert E. Daniels (Argonne National Lab., Ill.). Rev. Sci. Instr., 33: 487-8(Apr. 1962).

A switch for clamping-unclamping an electronic integrator for use with a monopolar signal of the zero gradient Argonne Synchrotron is described. The switch circuit shown is based on a flip-flop circuit controlled by voltage changes. A switching time of 1 μsec was easily obtained for unclamping, which was limited primarily by the open loop response of the amplifier. (N.W.R.)

17170 HIGH ORDER FOCUSING OF FLAT MONOENERGETIC ION BEAM BY HOMOGENEOUS SECTOR FIELD WITH ARBITRARY BOUNDARIES. V. R. Saulit. Vestnik Leningrad. Univ., No. 10, Ser. Fiz. i Khim., No. 2, 42-54(1961). (In Russian)

A method of calculation and the formulas defining the form of the sector boundaries with a homogeneous magnetic field giving exact focusing are deduced. (auth)

17171 DETERMINATION OF THE AMPLITUDES OF BETATRON AND SYNCHROTRON OSCILLATIONS OF ELECTRONS BY RAPID MOVING PICTURE PHOTOGRAPHY. A. G. Ershov (Moscow State Univ.). Zhur. Ekspt'. i Teoret. Fiz., 42: 606-9(Feb. 1962). (In Russian)

Results of a theoretical calculation of axial and radial distributions of the electron intensities over the cross section of a bunch are given. A method is presented which can be employed to determine the betatron and synchrotron oscillation amplitudes from the experimental intensity distributions. The method is based on the above mentioned calculation. Some new data regarding the variation of the radial oscillation amplitudes in the FIAN C–60 synchrotron during the acceleration process are presented. (auth)

17172 VERTICAL FOCUSING IN A MICROTRON. V. N. Melekhin (Inst. of Problems in Physics, Academy of Sciences, USSR). Zhur. Ekspt'. i Teoret. Fiz., 42: 622-4(Feb. 1962). (In Russian)

Results are presented on the calculation of vertical motion in a microtron. The calculations are performed for various shapes of the flight holes in the accelerating cavity. It is demonstrated that substitution of slits for the holes may significantly improve vertical focusing. (auth)

17173 DEVICE FOR SEPARATING ELECTRONS IN ACCORDANCE WITH THEIR ENERGY LEVELS. Hubert P. Leboutet and Jacques P. Pinel (to Compagnie Generale de Telegraphie sans Fil). U. S. Patent 3,031,596. Apr. 24, 1962.

A separator device is designed for high-energy electron beams from linear electron accelerators. The device comprises a plurality of magnets having parallel lines of force, some of the lines being opposite to the others. The magnets bend the path of the electrons in such a way that electrons of lower energies move along longer paths, and means are provided for extracting electrons of a predetermined energy from the device. (D.L.C.)

Plasma Physics and Thermonuclear Processes

Refer also to abstracts 16912 and 16913.

17174 (AD-266636) [PART] I. DYNAMICAL SIMILARITY AND [PART] II. INTRINSIC RELATIONS IN MAGNETOHYDRODYNAMICS. Technical Summary Report. R. P. Kanwal (Wisconsin. Univ., Madison. Mathematics Research Center). Sept. 1961. Contract DA-11-022-ORD-2059. 10p. (MRC-260)

A discussion is presented on the constancy and similarities of dynamics such as: magnetic Reynolds number, magnetic Mach number, the ratio of the viscous and magnetic diffusivities, Hartman number and various combinations of these values. In addition, an analysis is made of some of the intrinsic equations of magnetogasdynamics. (auth)

17175 (AFCRL-1028) DIFFUSION OF A PLASMA ACROSS A MAGNETIC FIELD. Report No. 61-9. Ronald Stephen Finn (Massachusetts Inst. of Tech., Cambridge. Magnetogasdynamics Lab.). July 1961. Contract AF19(604)-4551. 19p.

An investigation of the problem of plasma diffusion through a magnetic field was made through the macroscopic fluid equations. The problem was set up in a simple one-dimensional geometry of a semi-infinite half-space filled with plasma facing a semi-infinite half-space containing a uniform magnetic field, and the equations were used to describe their subsequent behavior. An attempt was made to solve the equations analytically, but their final solution was obtained numerically. The solutions were also used to determine temperature and entropy increases in the plasma. (auth)

17176 (JÜL-33-PP) UNTERSUCHUNG DES AUFBAUES EINER ELEKTRODENLOSEN RINGENTLADUNG MIT HILFE VON MIKROWELLEN. (Study of the Structure of an Electrodeless Ring Discharge Using Microwaves). H. Beerwald (Kernforschungsanlage. Institut für Plasmaphysik, Jülich, Germany). Jan. 1962. 11p.

The growth of electron density of a damped electrodeless ring discharge in H is investigated by means of a microwave-interferometer. The influence of RF-preionization and superposed static magnetic field is studied. It is concluded that the electron density grows stepwise when the magnetic field is near to zero. (auth)

17177 (JUL-36-PP) METHODS FOR THE PRODUCTION OF HIGH DENSITY, HIGH TEMPERATURE PLASMAS BY MAGNETIC COMPRESSION UNDER CONTROLLED INITIAL CONDITIONS. H. L. Jordan (Kernforschungsanlage. Institut für Plasmaphysik, Jülich, Germany). Jan. 1962. 18p.

A general experimental technique was developed which allows the formation of a plasma with controlled amounts of internal magnetic field, and the subsequent compression of this plasma. Three capacitor banks which can be switched with a high precision consecutively on the same compression coil are used. As the same compression coil is used in all stages of the experiment, this technique preserves symmetry and can therefore be applied for different field configurations and coil dimensions, in contrast to other methods for preheating. Results of other experiments show that in the preheating phase an almost fully ionized, uniform plasma with low impurity content and controlled amount of internal magnetic field is formed. By the subsequent fast compression of this initial plasma, a high density and high temperature plasma is obtained in a fully reproducible way. The ratio β of kinetic pressure to external magnetic pressure can be made small or close to 1. A pilot experiment proved the effectiveness of the method. (auth)

17178 (ML-793) INVESTIGATION OF MICROWAVE PROPERTIES OF PLASMAS. Final Report, November 1, 1960–January 31, 1961. (Stanford Univ., Calif. Microwave Lab.). Feb. 1961. Contract AF19(604)-5226. 51p. (AFCRL-346; AD-268148)

The microwave properties of plasmas were investigated, and in particular, the interaction of plasmas with electromagnetic radiation in the microwave frequency range, the interaction of plasmas with electron beams, and the behavior of plasma as a transmission medium for microwave signals, including the effect of very high-power pulsed microwave signals. Microwave signals and electron beams were used as tools for investigating properties of plasmas, including such things as oscillation and the effects of microwave power in producing ionization. (auth)

17179 (RADC-TN-61-99) PROPAGATION PROPERTIES OF NONUNIFORM IONIZED MEDIA. Gerald Levy (Rome Air Development Center, Griffiss AFB, N. Y.). Oct. 1961. 24p. (AD-266112)

The behavior of plane electromagnetic waves in ionized gases is attributed to the dispersion caused by the oscillation of the free electrons and the dissipation caused by the collision of these electrons with neutral particles during their oscillations. Further, since plasma media normally encountered in practice is nonuniform and bounded, the effects of these properties upon the energy propagation are also considered. Both monochromatic and pulse signal transfer function of plasma media are studied. A method of approximation of a general electron density by multiple constant gradient slabs matched at their interfaces is suggested. (auth)

17180 (USCEC-83-212) THE CRITERION OF RAREFACTION OF PLASMAS. Toyoki Koga (University of Southern California, Los Angeles. Engineering Center). Mar. 1962. Contract AF49(638)-831. 12p. (AFOSR-2361)

According to the analysis of kinetic equations of particles in plasmas, the rarefaction of a plasma is defined. The criterion of rarefaction is the condition of the discrete binary interactions of particles which permits definition of a free path. Another part of the criterion is the comparison between the mean free path and a representative dimension of the field (the Knudsen number). The first condition is determined by the number density of particles and the temperature (the average energy of random motions of particles). In the regime of rarefaction, the basic kinetic equations are of the Boltzmann type. (auth)

17181 (AEC-tr-5033) A NECESSARY HYDROMAGNETIC STABILITY CRITERION FOR A PLASMA WITH REVOLUTION SYMMETRY. Claude Mercier (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). Translated from Report CEA-1863, 1961. 21p.

Also published in Nuclear Fusion, 1: 47-53(1960).

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 21652.

17182 (FTD-TT-61-149) THE NATURE OF THE LONG SPARK. I. S. Stekol'nikov—B. M. Vul, ed. Translation of "Priroda Dlinnoi Iskry" (a publication of the Publishing House of the Academy of Sciences, Moscow, 1960). 430p.

Results of a study are presented concerning the long spark that develops in air under normal conditions between electrodes in the strongly nonuniform field that develops between them on application of various voltage forms. A brief discussion on lightning is included. (J.R.D.)

17183 (JPRS-12990) NEWS OF HIGHER EDUCATIONAL INSTITUTIONS, MINISTRY OF HIGHER EDUCATION, RADIOPHYSICS SERIES. Translation of Izvestiya Vysshikh Uchebnykh Zavedniĭ, Radiofizika, 4: 591-784(1961). 420p.

A total of 30 notes and papers are included, for 2 of which separate abstracts were prepared. Papers not abstracted contain information concerning developments and phenomena in electromagnetic behavior. (J.R.D.)

17184 (JPRS-12990(p.54-75)) INSTABILITY OF A MAGNETOACTIVE PLASMA AGAINST HIGH-FREQUENCY ELECTROMAGNETIC DISTURBANCES. [PART] III. V. V. Zheleznyakov. Translated from Izvest. Vysshikh Ucheb. Zavedeniĭ, Radiofiz., 4: 619-29(1961).

Propagation of electromagnetic waves along magnetic fields in non-equilibrium homogeneous plasmas is considered. An expression is obtained for the time-dependent growth (damping) coefficient, assuming that this coefficient is small compared with the frequency and is the result of the dispersion equation imaginary terms. These terms lead to the appearance of the Landau damping in equilibrium plasma. (J.R.D.)

17185 (JPRS-12990(p.367-71)) CONCERNING ONE CASE OF ČERENKOV INSTABILITY IN NON-EQUILIBRIUM MAGNETOACTIVE PLASMA. M. S. Kovner. Translated from Izvest. Vysshikh Ucheb. Zavedeniĭ, Radiofiz., 4: 765-6(1961).

A discussion is presented concerning excitation of waves in plasma by charged particle beams. (J.R.D.)

17186 APPROXIMATE EQUATION FOR PERFECT GAS PLASMA. Donald P. Duclos, Daniel P. Aeschliman, and Ali Bulent Cambel (Northwestern Univ., Evanston, Ill.). ARS (Am. Rocket Soc.) J., 32: 641-2(Apr. 1962).

Approximate equations of state of an ionized gas are given in order that thermodynamic properties may be determined. In particular, a plasma is assumed which is in thermal equilibrium and which, although conducting, is neutral electrically. Temperatures are limited to up to 30000°K and electron densities to below 10^{18} particles per cubic centimeter. Equations are given and illustrated for nitrogen and oxygen at 5000 to 30000°K. (N.W.R.)

17187 PLASMA POTENTIAL MEASUREMENTS USING AN ION BEAM PROBE. G. R. Haste and C. F. Barnett (Oak Ridge National Lab., Tenn.). J. Appl. Phys., 33: 1397-9(Apr. 1962).

The space potential of the plasma contained in the DCX-1 was investigated using a beam of lithium ions. The ions were accelerated through a variable potential from a thermionic source and directed toward the plasma. The beam energy at which the transmission became significant was defined as the plasma space potential. The potentials obtained in this way showed an increase with plasma density but have only a weak dependence on the background gas pressure. (auth)

17188 INFLUENCE OF TENSOR CONDUCTIVITY ON END CURRENTS IN CROSSED FIELD MHD CHANNELS WITH SKEWED ELECTRODES. Boris Podolsky (Xavier Univ., Cincinnati). and A. Sherman. J. Appl. Phys., 33: 1414-18(Apr. 1962).

An investigation of the current and electric field distributions in the end region of a cross field MHD device (accelerator or generator), with skewed electrodes, was conducted for the case in which the plasma exhibits the Hall effect. To permit analytic solutions, a two-dimensional problem was considered wherein the plasma velocity and properties, and magnetic field intensity were taken to be constant and uniform. Solutions were obtained for values of $\omega\tau$ (ω = electron cyclotron frequency, τ = electron mean free time); they show that current flows for a considerable distance upstream of the beginning of the electrodes, that some current concentration exists at one of the electrode corners, and that displacing this electrode upstream reduces this current concentration. (auth)

17189 THEORY OF A PLASMA NEGATIVE RESISTANCE AMPLIFIER. J. Y. Wada and Z. A. Kaprielian (Univ. of Southern California, Los Angeles). J. Appl. Phys., 33: 1551-62(Apr. 1962).

The theory of a plasma negative resistance amplifier is presented based on an approximate quasi-electrostatic model of a modified quadrupole cavity containing a plasma column and hyperbolic quadrupole electrodes with side resonators. The theory is extended to plasmas with finite collision frequencies in a finite magnetic field. Using a nonlinear equation of the electron motion obtained by expanding the time varying applied electric field in Taylor's series, it is shown that the electrons in a plasma column behave as a nonlinear reactance and that a net signal amplification can be realized when sufficient pump power is properly applied. The effective noise contributed from the plasma can be reduced by decreasing the plasma electron collision frequency or the plasma density. A preliminary experimental result which indicates the presence of a nonlinear plasma interaction is described. (auth)

17190 CONVERGING SHOCK WAVES FOR NUCLEAR FUSION. K. Diebner (Staatliche Schiffsingenieurschule, Flensburg, Ger.). Kerntechnik, 4: 89-93(Mar. 1962). (In German)

A summarizing review of the application of converging shock waves in plasma physics is given. Starting from the theoretical and experimental research on spherical and cylindrical shock waves the most important proposals known are chronologically reported. The dimensions of the sphere and the amount of explosive necessary for the hollow sphere device and the combination of mechanical shock waves with adiabatic magnetic compression, preheating by gas discharges and spark discharges are discussed. The prospects of periodically working fusion reactor models on the basis of converging shock waves are explained. (auth)

17191 A NEW METHOD FOR THE DETERMINATION OF PLASMA ELECTRON TEMPERATURE AND DENSITY FROM THOMSON SCATTERING OF AN OPTICAL MASER BEAM. T. P. Hughes (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). Nature, 194: 268-9 (Apr. 21, 1962).

A method is proposed for measuring the temperature and relative density of electrons in a plasma with an optical maser beam. Multiple reflections of the beam could be used to enhance the beam power, and the scattered light and the self-luminosity of the plasma can be distinguished by their polarization properties. The scattering of the beam and its Doppler broadening can be used as a measure of the electron density and temperature, respectively.

An electron drift velocity in the scattering plane can also be detected. Limits are given for the temperature and density measurable with this method. Since this method will not disturb the plasma, it should be valuable in thermonuclear research. (D.L.C.)

17192 RELATIVISTIC LIMITS TO NON-LINEAR PLASMA OSCILLATIONS. A. Cavaliere (EURATOM-C.N.E.N., Frascati, Italy). Nuovo cimento (10), 23: 440-3(Jan. 16, 1962). (In English)

Some results are reported concerning one-dimensional oscillations of finite amplitude in a cold collisionless plasma. The finite-amplitude traveling waves are shown to exist for non-linear electron oscillations; however, their frequency depends on the maximum speed of electrons relative to ions. The finite traveling waves vanish when the frequency is essentially the plasma frequency corresponding to the effective mass of electrons at maximum speed. (N.W.R.)

17193 PLASMA STABILITY IN AN INHOMOGENEOUS MAGNETIC FIELD. B. Lehnert (Royal Inst. of Tech., Stockholm). Phys. Fluids, 5: 432-8(April 1962).

The problem of flute instabilities earlier discussed by Rosenbluth and Longmire and by the author is reconsidered. The theory is extended to include the influence of a mass velocity in the unperturbed state as well as compression and expansion effects arising from the inhomogeneity of the magnetic field. According to the latter effects, surfaces of constant density will not move with the fluid velocity. A description of the dynamics of density perturbations is made in terms of the fluid equations under the assumption of negligible Ohmic and viscous dissipation. Adiabatic and isothermal changes of state are discussed for a plasma with adiabatic and isothermal distributions of pressure and density in the unperturbed state. The plasma is found to be stable against flute disturbances of any wavelength, not only for cusped geometry, but also for mirror geometry under certain conditions. This is the case when the characteristic length $B/|\nabla B|$ of the magnetic field is less than twice the characteristic length $N/|\nabla N|$ of the unperturbed density distribution. The approximations of the present theory exclude a treatment of perturbations which extend across the whole plasma body. The compression mechanism which is responsible for the stabilization is a zero-order effect which is independent of the assumptions of isotropy and of the special forms of the unperturbed density and pressure distributions. (auth)

17194 STABILITY OF A PLASMA TORUS AGAINST DISTURBANCES NOT DEPENDENT ON THE AZIMUTH. R. Luest (Max-Planck-Institut für Physik und Astrophysik, Munich), E. Martensen, and B. R. Suydam. Phys. Fluids, 5: 439-44(Apr. 1962).

Perturbations of a plasma torus which are independent of azimuth are not covered by the general theory. A method for treating these special modes is presented, uniqueness theorems proved, and a rapidly converging numerical scheme for computation is given. It is also shown that these modes have the same behavior in a torus of infinite aspect ratio as do the corresponding ones in a cylinder; therefore the infinitely thin torus is stable against these modes. (auth)

17195 ONE-DIMENSIONAL PLASMA MODEL. John Dawson (Princeton Univ., N. J.). Phys. Fluids, 5: 445-59 (Apr. 1962). (MATT-58)

A one-dimensional plasma model consisting of a large number of identical charge sheets embedded in a uniform fixed neutralizing background is investigated by following the sheet motions on a high-speed computer. The thermalizing properties and ergodic behavior of the system are examined and found to be in agreement with the assumption that one is equally likely to find the system in equal volumes of the available phase space. The velocity distribution, Debye shielding, drag on fast and slow sheets, diffusion in velocity space, the Landau damping of the Fourier modes, the amplitude distribution function for the Fourier modes, and the distribution of electric fields felt by the sheets were obtained for the plasma in thermal equilibrium and compared with theoretically predicted values. In every case, except one, the drag on a slow sheet, the numerical results agreed with theory to within the statistical accuracy of the results. The numerical results for the drag on a slow sheet were about a factor of 2 lower than the theory predicted indicating that the approximations made in the theory are not entirely valid. An understanding of the cause of the discrepancy might lead to a better understanding of collisional processes in plasmas. (auth)

17196 OSCILLATIONS IN A RELATIVISTIC PLASMA. K. Imre (Univ. of Michigan, Ann Arbor). Phys. Fluids, 5: 459-66(Apr. 1962).

The linear oscillations in a hot plasma which is representable by the relativistic Vlasov equation with the self-consistent fields are investigated. The generalization of Bernstein's method for the relativistic case is used to obtain the formal solution of the linearized problem. Particular attention is given to the case when the system initially is in the relativistic equilibrium state. The dispersion equation is derived and studied for the case when the propagation is along the direction of the unperturbed magnetic field, considering the spatial dispersion explicitly. The asymptotic expansions are developed corresponding to the dispersion relations of the cases studied. It is found that transverse waves propagating along the unperturbed field are Landau damped if $\nu^2 \geq 1 - \Omega^2/\omega^2$, ν and Ω being the index of refraction and the gyrofrequency, respectively. In the absence of the external field the cutoff frequency, which is found to be the same for both longitudinal and the transverse modes, is shown to be a monotonically decreasing function of the temperature. (auth)

17197 MOTION OF CHARGED PARTICLES IN AN INHOMOGENEOUS MAGNETIC FIELD. Erik T. Karlson (Aktiebolaget Atomenergi, Stockholm). Phys. Fluids, 5: 476-86(Apr. 1962).

By means of a crossed electric field, charged particles can be forced to move from a region where the magnetic field is comparatively weak into a region where the magnetic field is much stronger, which leads to an increase in the density and the temperature of the plasma. However, if the density is not very low, the inertia drift gives rise to space charges, which modify the electric field and thus strongly influence the motion. The motion of the particles is studied in a two-dimensional case with the influence of the space charges taken into account. The results are that the particle trajectories are considerably changed, but the reduction in the drift velocity is of the same order of magnitude as if the space charges are neglected. If the inhomogeneity in the magnetic field is strong enough, a forbidden region will arise. The shape of this region is given and the currents resulting from the particle motion are computed. (auth)

17198 SOLUTIONS FOR A NONLINEAR SINGULAR MAGNETIC FLUX DIFFUSION EQUATION. Norman J. Zabusky (Princeton Univ., N. J.). Phys. Fluids, 5: 487-91(Apr. 1962). (MATT-79)

The interdiffusion of a uniform one-dimensional compressible and resistive plasma with a uniform one-dimensional magnetic field is described by a pair of coupled diffusion equations. These equations separate if one assumes a slow diffusion process. The magnetic flux diffusion equation is singular at the interface, as the magnetic field maintains a constant value at the interface. The analytic properties of the solution in the region of the interface is written in terms of the similarity variable z. The current density $j_y = -dh/dz$ at the interface is shown to be finite in the adiabatic approximation and singular (as $z^{-1/2}$) in the isothermal approximation. The results obtained for h and $-dh/dz$ show that the magnetic field penetration is smaller in the isothermal than it is in the adiabatic case. The interface moves into the magnetic field region so that its displacement from the equilibrium interface is proportional to c_i (time)$^{1/2}$, where c_i is greater in the adiabatic case than in the isothermal case. (auth)

17199 ELECTROMAGNETIC-WAVE PROPAGATION IN A PLASMA WITH NONLINEAR ELECTRICAL CONDUCTIVITY. Melvin Epstein (Aerospace Corp., El Segundo, Calif.). Phys. Fluids, 5: 492-6(Apr. 1962).

A small-perturbation analysis was carried out to determine the effect of a nonlinear electrical conductivity on the propagation of microwaves normally incident on a homogeneous, slightly ionized gas. The reflecting properties of the interface separating the ionized gas from free space were also determined. The measure of the nonlinearity is given by the quantity γ, which is the ratio of the energy acquired by the free electrons from the field to the kinetic energy of the electrons in the absence of an applied field. The solution was obtained by performing a series expansion of the field strength in powers of γ. Terms up to order γ^2 were retained. It was found that the nonlinearity can cause significant increases in both the wave number and the attenuation factor of the transmitted signal. The transmission coefficient associated with the interface may also be significantly reduced. The change in the phase shift across the interface due to the nonlinearity was found to be positive or negative, depending upon whether the signal frequency is greater or less than the plasma frequency, respectively. (auth)

17200 WAVE MOTION IN A TWO-COMPONENT PLASMA WITH ANISOTROPIC PRESSURE. R. K. Jaggi (Univ. of Maryland, College Park). Phys. Fluids, 5: 497-8(Apr. 1962).

The problem of wave propagation in a fully ionized plasma with an anisotropic pressure tensor is studied. As an example the results for the propagation of electron waves in the background of static ions along the magnetic field are summarized. In this case the waves separate into pure longitudinal and transverse waves. The equations given assume that the pressure tensor in equilibrium has only two different components, electrons or ions parallel to the magnetic field and electrons or ions in the plane perpendicular to the magnetic field. The equations of continuity, momentum conservation, and pressure are written separately for the electrons and ions with the neglect of third-order moments. In equilibrium the plasma is assumed to be at rest with a uniform magnetic field in a fixed direction. (N.W.R.)

17201 THE PLASMA-SHEATH BOUNDARY AT LOW PRESSURES. R. N. Franklin (Royal Military Coll. of Science, Shrivenham, Wilts., Eng.). Proc. Phys. Soc. (London), 79: 885-7(Apr. 1, 1962).

The plasma-sheath boundary regions of the positive columns of an electric discharge at low pressures are calculated and discussed. The correction factor for locating the sheath boundary is derived and explained. The criterion $M\overline{v^2} > kT$ for the formation of a sheath of a monoenergetic beam of ions of velocity v_0 leaving the plasma is translated into a inequality involving the ion current for the case of uniform ion generation in space. Limiting values of the fractional space charge as functions of the ratio of the Debye length to the size of the system are given for the correction factor (relating the current at the sheath boundary). (N.W.R.)

17202 FAST ION GAUGE FOR THE MEASUREMENT OF NEUTRAL GAS DENSITY IN THE PRESENCE OF MAGNETICALLY CONFINED PLASMA. Gerhard Lewin and George Martin (Princeton Univ., N. J.). Rev. Sci. Instr., 33: 447-9(Apr. 1962).

A hot filament ion gage with a calculated time constant of 130 μsec for D_2 at room temperature was developed to measure neutral gas density near a magnetically confined plasma. The plasma contribution to the collector current is determined by operating the device with the filament cold. The influence of emission, gas pressure, and magnetic field on gage sensitivity is given. Measurements taken on a stellarator demonstrate the use of the gage. (auth)

17203 PLASMA POTENTIAL PROBE USING ELECTRON TIME-OF-FLIGHT. J. C. Slattery and R. F. Kemp (Space Technology Labs., Inc., Canoga Park, Calif.). Rev. Sci. Instr., 33: 463-7(Apr. 1962).

A technique is described for measuring the potential within a plasma by monitoring the time-of-flight of a beam of electrons directed through the plasma. The electron beam, intensity modulated at 30 Mc, is accelerated to an initial velocity determined by its cathode potential. The velocity then varies from this initial value as the potential along the flight path varies, changing the arrival time of the 30-Mc signal at the collector. The phase of the collector signal is continuously compared to that of a reference signal derived from the intensity modulator. The phase comparator has an output which is linearly proportional to the phase difference between the two signals. The sensitivity of the technique depends principally on the energy of the electron beam and the response time of the circuits. Using 900-v electrons, it is possible to measure a potential of 2 v along a 10-cm path, or follow changes of this magnitude which occur in a microsecond. The sensitivity can be raised to look at potentials which change more slowly. Under the operating conditions used, 2 v along 10 cm represent a phase change of about 0.1°, or a time change of about 1×10^{-11} sec. (auth)

17204 THE SPATIAL EXPANSION OF A DISCHARGE IN THE GENERATION AND THE CHANNEL STRUCTURE. H. Schlumbohm (Universität, Hamburg). Z. Physik, 166: 93-108(1962). (In German)

The spatial expansion of a discharge was investigated under homogeneous field conditions, using an anode with a small central area separated from the remainder and wide band double beam oscillographic techniques. The discharge currents were initiated by electrons released along traces of single α particles in the gas between the electrodes. The α particles enter the gap volume through a small hole in the middle of the separated center of the anode. The measurements have shown that a secondary photon emission from the cathode causes a spreading over the total gap volume within the first few electron generations (N_2, air, and CO_2 at lower pressures). If a streamer mechanism occurs (O_2 and CO_2 at higher pressures), the discharge remains localized to the trace of the α particle, in which the avalanches yielded by the primary electrons have produced a high density of positive ions. New details of steamer mechanism are revealed by analyzing the rapid increase of the current during streamer formation. (auth)

17205 MEASUREMENT OF ELECTRON MOBILITY ACCORDING TO THE VARIATION OF PLASMA RESISTANCE IN A MAGNETIC FIELD. G. E. Pikus, N. S. Skvortsov, and V. G. Yur'ev (Inst. of Semiconductors, Academy of Sciences, USSR). Zhur. Ekspt'. i Teoret. Fiz., 42: 330-7(Feb. 1962). (In Russian)

Theoretical calculations and experimental data are presented which indicate the possibility of measuring electron mobilities on the basis of the change of the resistance of a thermodynamically equilibrium plasma in a magnetic field. (auth)

17206 INSTABILITY OF A PLASMA IN A TOROIDAL DISCHARGE EXCITED BY A TRAVELING ELECTROMAGNETIC FIELD. R. A. Demirkhanov, N. I. Leont'ev, A. I. Kosyĭ, and T. M. Filatova. Zhur. Ekspt'. i Teoret. Fiz., 42: 338-43(Feb. 1962). (In Russian)

The stability of a plasma excited by a traveling electromagnetic H-wave in a toroidal chamber is investigated experimentally. Instabilities of the beam type are observed in such a system; they are caused by interaction between the azimuthal current and plasma. (auth)

17207 ON THE THEORY OF TRANSITION RADIATION. E. A. Kaner and V. M. Yakovenko (Inst. of Radiophysics and Electronics, Academy of Sciences, Ukrainian SSR). Zhur. Ekspt'. i Teoret. Fiz., 42: 471-8(Feb. 1962). (In Russian)

The problem of transition radiation of a charged particle in a plasma is solved in the kinetic approximation, taking into account space dispersion. Mirror reflection of electrons from the plasma-vacuum boundary is assumed. The limiting cases of weak and strong space dispersion are considered for a nonrelativistic, as well as relativistic plasma. In the case of weak dispersion the radiative particle energy losses consist of a transition radiation and the Cherenkov radiation on longitudinal waves emitted in vacuum. The spectrum of the latter radiation is relatively narrow. In the strong space dispersion region expressions for the radiation field and particle energy losses can be derived in the surface impedance approximation. Radiative energy losses of a particle moving along the axis of a gyrotropic medium without space dispersion are calculated. The features of transition and Cherenkov radiation from an electron in a transparent medium are discussed. (auth)

17208 SOME FEATURES OF COLLECTIVE ENERGY LOSSES IN AN ANISOTROPIC PLASMA. I. O. Kulik (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Ekspt'. i Teoret. Fiz., 42: 543-51(Feb. 1962). (In Russian)

Plasma oscillations in a quasi-particle gas with an arbitrary dispersion law (anisotropic plasma) are considered. In the anisotropic case the function $\omega_p(k)$ which expresses the dispersion law of plasma oscillations depends (for a wave vector $k \to 0$) on the direction of propagation of the plasmon; this leads to a peculiar type of angular dependence of the characteristic energy losses in the small scattering angle region. Surface plasma waves in an anisotropic plasma are considered. The effect of retardation of the interaction on the spectrum of the characteristic losses is taken into account. The calculations are carried out for uniaxial cyrstals. (auth)

17209 EFFECT OF RADIATIVE EFFECTS ON ELECTRON RELAXATION AND ELECTRIC CONDUCTIVITY OF A PLASMA IN A STRONG MAGNETIC FIELD. A. I. Akhiezer, V. F. Aleksin, V. G. Baryakhtar, and S. V. Peletminskii (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Ekspt'. i Teoret. Fiz., 42: 552-64(Feb. 1962). (In Russian)

The effect of radiation and absorption of electromagnetic waves by plasma electrons in a strong magnetic field on the electron relaxation and electric conductivity of the plasma is investigated. Due to these processes relaxation in the transverse (relative to the magnetic field) component of the electron momentum may be attained in the relativistic case. The radiative relaxation time depends on the ratio of the mean electron energy to the mean radiation intensity in the magnetic field. If this time is smaller than the mean time between Coulomb collisions, it will determine the time required for an equilibrium electron distribution with respect to the absolute value of the transverse momentum component to be established. Radiation effects may also exert a significant influence on transfer phenomena in the plasma. In particular, the transverse conductivity of the plasma is determined by the combined effect of these processes as well as the Coulomb collisions, whereas the longitudinal conductivity is determined only by Coulomb collisions. (auth)

17210 ON THE DEVELOPMENT OF FLUCTUATIONS IN A PLASMA WITH AN UNSTABLE DISTRIBUTION FUNCTION. I. A. Akhiezer (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Ekspt'. i Teoret. Fiz., 42: 584-91(Feb. 1962). (In Russian)

An investigation is carried out of the development of fluctuations in a plasma with an unstable distribution function (mainly in the plasma-charged particle beam system). The expected values of the increasing oscillation amplitudes excited by the beam upon its traversal through the plasma are found and the correlation functions of various physical quantities (electric field, charge density of the system, beam density, and velocity) are determined. These correlation functions and the squares of the oscillation amplitudes contain terms which grow exponentially with time and an increment which is proportional to $N_B^{1/3}$, the pre-exponential factor also being proportional to $N_B^{1/4}$ (N_B is the beam density). If the beam velocity is large compared with the mean thermal velocity of the plasma electrons, resonance between the plasma oscillations excited by the beam and the Langmuir oscillations of the plasma will appear. In this case the correlation functions grow with an increment proportional to $N_B^{1/2}$, the pre-exponential factor being independent of the beam density. (auth)

17211 THÉORIES DES ONDES DANS LES PLASMAS. (Theory of Waves in Plasma). J. F. Denisse and J. L. Delcroix. Monographies Dunod, 33. Paris, Dunod, 1961. 175p.

The problem of wave propagation in plasma is presented for students. Absorption phenomena, nonlinear phenomena, microscopic representation of the plasma, and experimental data are not included in the review. The topics discussed are dispersion equations of plane waves, transverse electromagnetic waves, longitudinal waves, classification of waves and plasmas, the four modes of propagation in the general case, transverse propagation, propagation in cold plasmas, and magnetohydrodynamic waves. (J.S.R.)

17212 PROCESS FOR THE PRODUCTION OF ATOMIC ENERGY BY A CATALYTIC METHOD. Jacques Weiss. British Patent 893,783. Apr. 11, 1962.

A new industrial process is given for producing thermal energy from the fusion reaction of hydrogen. In this process, carbon is utilized as a catalyst, preferably in the form of a hydrocarbon. The fusion reaction may also be speeded up by x rays or gamma rays. (D.L.C.)

17213 IMPROVEMENTS RELATING TO THERMONUCLEAR REACTORS. George Thomson (to Associated Electrical Industries Ltd.). British Patent 894,848. Apr. 26, 1962.

A thermonuclear reactor, in which a high-current discharge is produced around a torus and confined therein by the self-induced magnetic field, is designed with means for obtaining electric power directly from the equipment. The means comprises collectors for collecting particles from along the torus and ion injectors arranged so that a potential difference is established between the collectors and injectors for extraction of power. (D.L.C.)

17214 THERMONUCLEAR REACTOR. (to U. S. Atomic Energy Commission). British Patent 894,914. Apr. 26, 1962.

A thermonuclear reactor of the Astron type, in which a layer of relativistic electrons is used to produce and confine a plasma, is designed with means for balancing the pressure exerted axially outward by plasma confined within the plasma boundary. The means comprises a pair of solenoids respectively and coaxially disposed outwardly from the end region of the closed field pattern. (D.L.C.)

17215 IMPROVEMENTS IN OR RELATING TO PLASMA CONFINING DEVICES. (to CSF Compagnie Generale de Telegraphie Sans Fil). British Patent 894,970. Apr. 26, 1962.

A plasma-confining device of the conventional toroidal shape with confining magnetic mirrors is designed in which the transverse escape of plasma particles by diffusion is reduced. The device is coupled to a wave guide for propagating uhf electromagnetic waves in its interior to assist the magnetic field in its confining action on the plasma. (D.L.C.)

17216 IMPROVEMENTS IN IONIZATION CHAMBERS OF HIGH TEMPERATURE PLASMA GENERATORS. Jules Cyprien, Joseph Poujade and Alain Camille Hadancourt (to Societe Nationale d'Etude et de Construction de Moteurs d'Aviation). British Patent 895,030. Apr. 26, 1962.

An ionization chamber is designed for improved production of plasma jets at very high temperatures. The chamber comprises a wall as the cathode and with an opening for the outlet of the plasma jet, and an anode mounted on the axis of the outlet opening and projecting into the chamber interior. The anode has an internal passage having a rear portion for gas intake and a front portion of one or more annular outlet ports which are set back with respect to the head thereof. The arrangement of the outlet ports enables the profile of the head to be designed to shape the flow and field structure in any desired form. (D.L.C.)

17217 HIGH-FREQUENCY UTILIZATION APPARATUS FOR IONIZED GAS. Robert R. Warnecke and Germaine Vincent (to Compagnie Generale de Telegraphie sans Fil). U. S. Patent 3,031,399. Apr. 24, 1962.

An apparatus is designed for compressing a plasma within a cavity resonator by means of a high-frequency electromagnetic field. The apparatus is provided with automatic frequency control means for increasing the efficiency of the compression. (D.L.C.)

17218 DESTRUCTION OF NEUTRAL PARTICLES IN A DEVICE FOR PRODUCING A HIGH DENSITY PLASMA. A. Simon (to U. S. Atomic Energy Commission). U. S. Patent 3,032,490. May 1, 1962.

A method and apparatus are described for burning out neutral particles in an evacuated region and within a strong magnetic field. The method comprises injecting energetic molecular ions into the region perpendicular to the magnetic field and into the path of a dissociating, energetic arc discharge, the atomic ions formed in the dissociating process being trapped by the magnetic field, and then increasing the value of the trapped atomic ion current to such a value that the neutral particles are destroyed faster than they are formed, thereby causing a dense, energetic plasma to be built up and sustained by the magnetic field. (AEC)

17219 FAST ACTING CURRENT SWITCH. Thomas H. Batzer, David B. Cummings, and James F. Ryan (to U. S. Atomic Energy Commission). U. S. Patent 3,036,172. May 22, 1962.

A high-current, fast-acting switch is designed for utilization as a crowbar switch in a high-current circuit such as used to generate the magnetic confinement field of a plasma-confining and heat device, e.g., Pyrotron. The device particularly comprises a cylindrical housing containing two stationary, cylindrical contacts between which a movable contact is bridged to close the switch. The movable contact is actuated by a differential-pressure, air-driven piston assembly also within the housing. To absorb the acceleration (and the shock imparted to the device by the rapidly driven, movable contact), an adjustable air buffer assembly is provided, integrally connected to the movable contact and piston assembly. Various safety locks and circuit-synchronizing means are also provided to permit proper cooperation of the invention and the high-current circuit in which it is installed. (AEC)

17220 METHOD AND APPARATUS FOR INJECTING AND TRAPPING ELECTRONS IN A MAGNETIC FIELD. Nicholas C. Christofilos (to U. S. Atomic Energy Commission). U. S. Patent 3,036,963. May 29, 1962.

An apparatus is designed for the manipulation of electrons in an axially symmetric magnetic field region and may be employed to trap electrons in such a field by directing an electron beam into a gradientially intensified field region therein to form an annular electron moving axially in the field and along a decreasing field gradient. Dissipative loop circuits such as resistive loops are disposed along at least the decreasing field gradient so as to be inductively coupled to the electron bunch so as to extract energy of the electron bunch and provide a braking force effective to reduce the velocity of the bunch. Accordingly, the electron bunch upon entering a lower intensity magnetic field region is retained therein since the electrons no longer possess sufficient energy to escape. (AEC)

Shielding

Refer also to abstract 16187.

17221 (DC-52-5-41) HYDROGENOUS SHIELD MATERIALS. Status Report, Milestone B. C. C. Thomas, Jr. (General Electric Co. Aircraft Nuclear Propulsion Project, Cincinnati). May 29, 1952. Contract [AT(11-1)-171]. 15p.

Hydrogenous materials other than water have been suggested as neutron shield materials for use in the Improved Engine Test Reactor. These materials would have high boiling points, low densities, and high hydrogen contents which would make them more desirable than water. Eightythree such materials were irradiated with a gamma flux of 1.2×10^{11} $\gamma/cm^2/sec$ for 30 min at 150°C (302°F). The total exposure dose was 2.5×10^6 r. The rate of gas evolution, pressure rise, and melting points and/or indices of refraction are presented. Of the 83 materials, 13 that exhibited low gas evolution were selected for further study. (auth)

17222 (NP-11466) SHIELDING: AN ANNOTATED BIBLIOGRAPHY. William L. Hollister, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Feb. 1962. Contract AF04(647)-840. 165). (SB-62-2)

A bibliography on shielding was compiled in connection with a study of radiation hazards on the lunar surface. The 338 references include works on the subject of reactor shielding both on land and in nuclear-powered space vehicles, shielding against trapped radiation belts, cosmic rays, and solar flares. Both theoretical and empirical studies are included. The references cover the period from 1958 to February 1962, and are arranged alphabetically by author. Corporate author and subject indexes are given. (M.C.G.)

17223 IMPROVEMENTS IN AND RELATING TO BUILDING MATERIAL, STRUCTURAL ELEMENTS AND STRUCTURES FOR PROTECTION AGAINST RADIATION. Heinrich Drath. British Patent 894,494. Apr. 26, 1962.

A shielding material for protection against x and gamma radiations and neutrons is described. The material consists of cement or concrete to which finely divided minerals or ores containing heavy metals are added. The material is economical and weakens hard rays more effectively than lead. (D.L.C.)

Theoretical Physics

17224 PROPERTIES OF A SOLUTION OF THE LOW EQUATION FOR A LOCAL FIELD THEORY MODEL. B. M. Barbashov and G. V. Efimov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 520-5(Feb. 1962). (In Russian)

A solution of the Low equation is obtained for the scattering amplitude of scalar mesons on a fixed nucleon which may exist in two states differing in mass. The solution is valid only if a certain restriction is imposed on the coupling constant g_r. The Low amplitude is compared with the solution derived on basis of the Hamiltonian formalism. For energies $\omega < 2\mu$ the contributions from many-particle states to the scattering amplitude are found to be unimportant. The relation between the resonance solution and the nonphysical pole in the amplitude is discussed. (auth)

17225 INVARIANT FORMULATION OF THE GRAVITATIONAL WAVE FIELD THEORY. Yu. B. Rumer (Inst. of Radiophysics and Electronics, Siberian Branch, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 577-83(Feb. 1962). (In Russian)

Einstein's theory of gravitation is formulated in such a way that the main quantity which emerges is the gravitational field strength 4-tensor F_{iklm} which is linearly connected with the Riemann curvature tensor R_{iklm} and vanishes in Euclidean space. The gravitation equations which can be employed to compute F_{iklm} as well as g_{ik} for given sources formally coincide with the Bianchi identities. The main advantage of the new formulation is that it permits an invariant theory of weak gravitational waves to be set up. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

17226 (AEEW-R-117) BURN-OUT ANALYSIS. PART I. A BURN-OUT CORRELATION FOR WATER IN ROUND AND RECTANGULAR CHANNELS UNIFORMLY HEATED AT VARIOUS PRESSURES WITH FORCED CONVECTION. R. V. Macbeth (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Nov. 9, 1961. 38p.

The practical objective of research on burn-out is a reliable method giving the maximum safe rating for any water cooled reactor. Experimental work, which began at numerous centers about 10 years ago, was concerned principally with endeavoring to understand the phenomenon as it applies to simple geometries such as round and rectangular channels. This considerable effort has achieved little real success in providing an explanation of burn-out however. While some uncertainty may be due to experimental variations, inadequate analytical effort is considered to be the primary cause of the present confused situation. The result of some work already carried out is described. An initial examination made on a large group of burn-out data is described and the development is reported of a correlation which predicts burn-out heat fluxes to within an R.M.S. error of less than 10% over a wide range of operating conditions including pressure. (auth)

17227 (BAW-1230(Pt.I)) SPECTRAL SHIFT CONTROL REACTOR BASIC PHYSICS PROGRAM—THEORETICAL ANALYSIS. PART I. ANALYSIS OF EXPERIMENTS. D. B. Wehmeyer, J. M. Doederlein, K. E. Roach, and W. A. Wittkopf (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Mar. 1962. Contract AT(30-1)-2602. 146p.

The data obtained in the series of SSCR experiments and the theoretical analysis of the results demonstrate the spectral shift control principle clearly. The critical assemblies show that considerably larger amounts of fuel can be loaded into a core moderated with a mixture of D_2O and H_2O than in one moderated with H_2O alone. The measured Cd ratios and the calculated neutron balances show that the excess reactivity associated with this extra mass is held up in the resonance absorption of the fertile material. This leads to a higher conversion ratio system than the same sized lattice controlled by thermal neutron poison. Very good agreement is obtained between experimental and theoretical values for nearly all important parameters over the entire range of D_2O concentration in the moderator. This agreement confirms the use of the BPG-four-group treatment, and demonstrates the calculation of reactor criticality and other measured integral parameters from fundamental cross sections without the use of intermediate fitting functions. The reactor leakage part of the calculational model is shown to be accurate by the good agreement obtained between calculated and experimental values of age, criticality, change of criticality with moderator height, and the comparison between boric acid poisoning and reactivity holddown with D_2O. Comparison of measured and calculated Cd ratios indicates that the model gives good values of resonance absorption for U^{238} and of resonance fission for U^{235}. The accurate criticality results also confirm this. More cross section and lattice Cd ratio data are needed for Th before definitive conclusions can be reached. In two areas theory and experiment do not agree. Further analytical and experimental work is needed to obtain better results in the analysis of thermal flux ratios. There is definite disagreement between calculated and measured temperature defect, and effort should be exerted to resolve the discrepancy. The good agreement between theory and experiment justifies the use of the model in this series of experiments, but the experiments were all performed with the same moderator volume fraction and fuel. Further confirmation would be useful at other moderator volume fractions and fuel enrichments. (auth)

17228 (BAW-1233) SPECTRAL SHIFT CONTROL REACTOR BASIC PHYSICS PROGRAM. EXPONENTIAL EXPERIMENTS AT ELEVATED TEMPERATURES ON LATTICES MODERATED BY D_2O-H_2O MIXTURES. L. G. Barrett, H. J. Worsham, and T. C. Engelder (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Mar. 1962. Contract AT(30-1)-2602. 74p.

Results of exponential experiments conducted at elevated temperatures on rod lattices of slightly-enriched UO_2 moderated by D_2O-H_2O mixtures are summarized. The fuel rods, 4%-enriched UO_2 swaged in stainless steel, were 0.476-inch OD by 0.016-inch wall. The non-moderator-to-moderator volume ratio was 1.006. The two moderator compositions studied were light water (0% D_2O) and a D_2O-H_2O mixture containing 81.5 mole % D_2O. The experimental facility and techniques are described. Material buckling values derived from radial and axial flux measurements are also summarized. (auth)

17229 (BMI-1565(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JANUARY 1962. Russell W. Dayton and Clyde R. Tipton, Jr. (Battelle Memorial Inst., Columbus, Ohio). Feb. 1, 1962. Contract W-7405-eng-92. 88p.

Progress is reported on reactor materials and components, studies of fuels, general fuel-element development, growth of UO_2 single crystals, radioisotope and radiation applications, materials development and evaluation, coated-particle fuel materials, materials-development program, fuel irradiation program, corrosion studies of the Fluoride-Volatility Process, progress on the USAEC-AECL cooperative program, radiation-effects study of candidate fuel materials for the MGCR, materials development studies for SM reactors, gas-cooled reactor program, and gas-pressure bonding of beryllium-clad elements. (M.C.G.)

17230 (CEA-1855) LE BRUIT NEUTRONIQUE DES RÉACTEURS NUCLÉAIRES. (Neutron Noise in Nuclear Reactors). Austin Blaquière (France. Institut National des Sciences et Techniques Nucléaires, Paris) and Roza Pachowska (Warsaw. Technical Univ.). 1961. 26p.

The power of a nuclear reactor, in the operating conditions, presents fluctuations due to various causes. This random behavior can be included in the study of "noises." Among other sources of noise, an analysis is made of the fluctuations due: a) to the discontinuous emissions of neutrons from an independent source, and b) to the multiplication of neutrons inside the reactor. The method which is presented makes use of the analogies between the rules governing a nuclear reactor in operation and a number of radioelectrical systems, in particular the feed-back loops. The reactor can be characterized by its "passing band"

and is described as a system submitted to a sequence of random pulses. In nonlinear operating conditions, the effect of neutron noise is defined by means of a nonlinear functional; this theory is thus related to previous works, the references of which are given. This leads in the case of nuclear reactors to some results given by A. Blaquière in the case of radioelectrical loops. (auth)

17231 (CEA-2115) FLUCTUATIONS D'UN SYSTEME DEPENDANT DE PLUSIEURS PARAMETRES ALEATOIRES. APPLICATION AUX REACTEURS NUCLEAIRES. (Fluctuations in a System Depending on Several Random Parameters. Application to Reactors). A. Blaquiere and R. Pachowska (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1962. 101p.

A method was previously developed for studying neutronic fluctuations in nuclear reactors using the analogy between the behavior of a reactor and that of certain common radioelectric circuits. The fluctuations may then be calculated by introducing into the circuit a suitable noise source. By this method the over-all fluctuations in a particularly simple form were considered and a physical significance was provided for certain results obtained more laboriously by other methods. The object of the report is to generalize this method and in particular to extend it to the case of a reactor having a cellular structure and to apply it to fluctuations within a cell. It is thus shown that the fluctuations in a cell are the resultant of a rapidly evolving poissonian noise, not related to the over-all fluctuations; and a slowly evolving noise, when the reactor is not too far from criticality, which is related to the over-all fluctuations. The relationship of the new method to the old methods is also stressed. Pile fluctuation theory is placed in a more general framework, that of the fluctuations of a system depending on several random parameters; from this point of view, the method could easily be transposed and adapted to the study of other physical problems of this type. (auth)

17232 (CRC-1058) AXIAL FLUX DISTRIBUTION IN A LATTICE POSITION IN THE NRX REACTOR. I. E. Bock and A. W. Boyd (Atomic Energy of Canada Ltd., Chalk River, Ont.). Mar. 1962. 39p. (AECL-1481).

The axial thermal flux distribution in a lattice position in the NRX reactor was measured at a number of moderator levels. The results were fitted to sine functions, and values are given for the positions of the flux maxima and the extrapolated flux lengths. Results of measurements of the axial fast flux distribution are also given. (auth)

17233 (CRRP-985-D) EXPERIMENTAL NEUTRON SPECTRA IN A CYLINDER OF HOT MODERATOR. C. B. Bigham, R. B. Turner, and B. G. Chidley (Atomic Energy of Canada Ltd., Chalk River, Ont.). Feb. 1962. 62p. (AECL-1471)

Relative reaction rates in selected nuclides were measured through the central lattice cell of ZEEP with the fuel cluster replaced by a pressure tube containing different mixtures of light and heavy water. Room temperature heavy water surrounded the pressure tube. Measurements were made with the pressure tube filled with air and four mixtures ranging from reactor grade heavy water to light water, at temperatures up to 280°C. The radial variations are given for the reaction rates, which were measured, and for the effective neutron temperature T, the epithermal index $r\sqrt{T/T_0}$ and the slowing down spectrum, all deduced from the reaction rates. (auth)

17234 (DP-641) PDP MEASUREMENTS OF COOLANT VOID REACTIVITY COEFFICIENTS. Albert E. Dunklee (Du Pont de Nemours (E. I.) and Co. Savannah River Lab., Aiken, S. C.). Mar. 1962. Contract AT(07-2)-1. 22p.

Measurements in the Process Development Pile (PDP) determined the effect on reactivity of removing all D_2O coolant from pressure tube fuel assemblies consisting of four concentric U metal tubes ranging in outer diameter from 1.06 to 3.08 in. and immersed in D_2O moderator. At a triangular lattice pitch of 9.33 in. between the centers of the fuel assemblies, the measured increase in the multiplication constant of an infinite lattice was 2.8%. This result confirmed earlier calculations and exponential experiments which indicated that this type lattice of nested U metal tubes would be unstable in a boiling-D_2O-cooled power reactor. (auth)

17235 (IDO-16750) QUARTERLY TECHNICAL REPORT [ON] SPERT PROJECT, OCTOBER, NOVEMBER, DECEMBER 1961. F. Schroeder, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 15, 1962. Contract AT(10-1)-205. 33p.

Spert I. An analysis of the transient temperature distribution in the fuel rod employed in the water-moderated, low-enrichment UO_2 core was performed. The calculated central and surface temperatures at peak power for reactor transients of different reactor periods were found to be in good agreement with earlier experimental data. Spert II. The fuel-plate temperature distribution, heat transfer rate, and energy partition between fuel plate and water were calculated from the reactor power and surface temperature data for a D_2O-moderated core. The reduced prompt neutron lifetime for the D_2O-moderated core was calculated from step-transient test data and compared with the statistical value. Spert III. Tests were performed to study the effects of coolant flow on the kinetic behavior of the reactor at elevated temperatures. Forced coolant flow was found to reduce the initial power peak for a 20-msec period excursion at 93°C, 2500 psig and 116°C, 200 psig. The system temperature response to the startup of a stagnant loop at 430 and 440°F, with the primary circulating loop at 450°F, was investigated. Engineering. The material of two failed Spert II core structure bolts was found to be of 17-4 PH, not 17-7 PH as specified. Review of the failure in the Spert III pressurizer vessel indicates that it was due to overheating and high-temperature creep. (D.L.C.)

17236 (NAA-SR-6893) ENERGY ABSORPTION RATES IN OMR COOLANTS. D. Duncan (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 15, 1962. Contract AT(11-1)-Gen-8. 35p.

The amount of energy absorbed by the organic coolants of the OMRE and Piqua reactors was calculated. New techniques were developed for calculating energy deposition by neutrons, gamma rays, and beta particles. Fast neutron energy absorption was determined, using a modified version of the FORM code. A method was developed to calculate the fraction of the gamma energy produced which is absorbed by organic coolant inside the core. Gamma leakage from the core was handled by using a modified version of the GRACE II code. The energy absorbed by the coolant of the OMRE resulting from fission-product betas escaping the clad fuel regions was also determined. The percent of the total reactor power absorbed by the coolants of the OMRE and Piqua reactors is 9.04 and 2.94, respectively. These results are presented in such a manner that energy absorption rates for future OMR-type reactors may be easily extrapolated. (auth)

17237 (NASA-TN-D-1184) A MONTE CARLO STUDY OF RESONANCE ESCAPE PROBABILITY IN HETERO-

GENEOUS SLAB LATTICES CONTAINING RESONANT ABSORBERS AND SCATTERERS. Harold Schneider, Leo Levitt, and Kevin J. Sroub (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Apr. 1962. 94p.

Resonance escape probabilities for heterogeneous semi-infinite slab lattice systems were computed by the Monte Carlo method at 1 kev to 0.125 ev. Absorber-moderator combinations considered were W–H_2O, W–LiH, W–BeO, Au–H_2O, Au–LiH, and Au–BeO. Absorber and moderator thickness and absorber temperature were varied in a parametric study. The Monte Carlo results of neutron absorption for various thicknesses of W and Au slabs at room temperature are in good agreement with experimental results from NASA solution reactor absorption measurements on comparable W and Au samples. (auth)

17238 (NEI-168) THE CALCULATION OF THERMAL UTILIZATION BY A COLLISION PROBABILITY METHOD INCLUDING SCATTERING AND SOURCES IN THE ANNULI SURROUNDING THE FUEL. C. D. McKay (Atomic Energy of Canada Ltd., Chalk River, Ont.). Oct. 1961. 25p. (AECL-1474)

A method was developed for calculating the thermal utilization of a lattice cell consisting of a homogeneous cylinder which absorbs, scatters, and produces thermal neutrons, surrounded by a number of weakly absorbing annuli which are thin compared with one total mean free path and to the radius of the annulus but which scatter and produce thermal neutrons. The chief difficulty with the method as formulated is that slightly different answers can be obtained for the same physical problem by dividing up a thick annulus into thinner ones by inserting virtual interfaces. This effect is small and usually negligible. (auth)

17239 (ORNL-TM-203) MURGATROYD—AN IBM 7090 PROGRAM FOR THE ANALYSIS OF THE KINETICS OF THE MSRE. C. W. Nestor, Jr. (Oak Ridge National Lab., Tenn.). Apr. 6, 1962. Contract W-7405-Eng-26. 25p.

The IBM 7090 program Murgatroyd is a revised and extended version of the IBM 704 program PET-I, which solves (by a fifth-order Runge-Kutta procedure) the coupled first-order differential equations for power, delayed neutron concentration, and temperature in a one-region reactor as a function of time, given an input reactivity variation represented by a series of linear ramps. The basic extensions were those which were necessary to include the effects of the separate heat capacities and temperature coefficients of the fuel salt and graphite in the MSRE, and of heat transfer between the fuel and graphite. In addition, the input and output sections of the previous program were modified to facilitate the use of the program in extensive parameter studies, and a calculation of the pressure rise in the core was included. Typical running times are of the order of 12 milliseconds per time step; a calculation of a 30-second power history using a 10 millisecond time step requires about 36 seconds of machine time. (auth)

17240 (TRG-Report-130) A REVIEW OF LONG-TERM REACTIVITY CHANGE CALCULATIONS. F. P. O'Dell (United Kingdom Atomic Energy Authority. Reactor Group, Risley, Lancs, England). Oct. 19, 1961. 18p.

The methods of calculation of long term reactivity changes, and moderator temperature coefficients used for the design of reactors of the Calder Hall type is outlined. Calculation results are compared with the observed effects on the Calder Hall reactors and the effect of the spectrum temperature assumption is demonstrated. A brief review is given concerning the influence of such changes on the design of other reactors and some indication is presented of the scope of design calculations required to study the perturbing effects of burn-up and fuel cycle on the maximum fuel element temperatures. (auth)

17241 (UNC-5005) HEAVY WATER-MODERATED POWER REACTOR PROGRAM. Quarterly Progress Report for Period Ending March 31, 1962. (United Nuclear Corp. Development Div., White Plains, N. Y.). Apr. 1, 1962. Contract AT(30-1)-2836. 17p.

The series of experiments with tubular UO_2 fuel clusters was completed and the results are presented. In addition to standard k_∞ and f measurements several remote voiding experiments were performed. These measurements were analyzed to yield void coefficients for individual channels as a function of lattice pitch and of coolant purity at one pitch. Also included are the updated results of the experiments to determine the lattice pitch variation of k_∞ for bare 37-rod and 31-rod clusters of 0.50 in. UO_2 fuel. (auth)

17242 (AEC-tr-4995) THE STATIC HYDRAULIC STABILITY OF BOILING WATER REACTORS. H. Kornbichler. Translated from Atomkernenergie, 5: 397-400 (1960). 16p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 5794.

17243 FORMULA FOR THE FUEL ELEMENT CHARGING OF REACTORS. E. Kern (Brown Boveri Krupp Reaktorbau GmbH, Mannheim, Ger.). Atomkernenergie, 7: 1-14 (Jan. 1962). (In German)

The calculation of the long-term reactivity of reactors is only possible with great mathematical efforts; since the burn-up (including conversion and poisoning) is dependent on the neutron flux and on the concentration of the fuel components, which are both variable with regard to time and space, and the fuel charging required for an operation with constant reactor power depends on its part in a complicated manner on the burn-up. The results of the calculation of the burn-up show that the fuel charging reaches a stationary state after a short period of operation. The speed of charging is then constant, the distribution of concentration of the fuel components in the core, the neutron flux etc. are frozen. The two characteristic values of the fuel charging, the speed of charging in the beginning of the operation and in the stationary state, can be represented by means of simple formulas, which can be numerically evaluated without using an electronic computer. It is shown how these formulas are derived from the general formalism of the burn-up calculation, which represents a nonlinear, time-dependent, mixed initial and boundary value problem with non-constant boundaries. Furthermore formulas for an elementary application are given for the maximum neutron dose of the fuel in the reactor and for the stationary local distribution of the neutron dose and neutron flux. The distribution of the fuel components in the reactor, e.g. that of the fissile material, the bred plutonium, the fission products etc., can be calculated from the distribution of the neutron dose, which characterize the burn-up, conversion, and poisoning. (auth)

17244 LONG TERM REACTIVITY CHANGES IN NATURAL URANIUM GRAPHITE LATTICES. P. Basso and G. Ghilardotti (AGIP Nucleare, Milan). Energia nucleare (Milan), 9: 8-20(Jan. 1962). (In English)

When uranium fuel is irradiated in a reactor changes occur in fuel composition which affect the reactivity balance of the system. The long term reactivity changes being the net result of many contributions of the same order of magnitude but with opposite effects, such as U^{235} destruction, Pu isotopes, and fission products build-up, the theoretical estimate of the over-all reactivity change requires some care. The different contributions to reactivity changes with irradiation in natural uranium graphite lattices are analyzed in detail, with the aim to determine to what extent approximations can be used and where an exact treatment is justified. Moreover, an attempt at evaluating the effect on long term reactivity calculations of the existing uncertainties in nuclear data is made. The results are to be considered as representative of a local situation, and should be properly averaged in order to obtain information on the long term behavior of the whole reactor. (auth)

17245 CHEMICAL STABILITY OF METALLIC FUEL ELEMENTS IN GAS-COOLED REACTORS. R. Darras (Commissariat à l'Énergie Atomique, [Paris]). Inds. atomiques, 5: No. 11-12, 43-9(1961). (In French)

After a survey of the problem with respect to the characteristics of reactors in operation and under construction, the results of a study made at Saclay on the fast combustion of magnesium, uranium, and their alloys in dry or humid air or carbon dioxide are reported. A critical examination of the risks of rapid combustion and its possible consequences in the reactors considered is made. (tr-auth)

17246 AN INDUSTRIAL TRAINING PROGRAM IN ADVANCED REACTOR ENGINEERING. T. Dreier (Knolls Atomic Power Lab., Schenectady, N. Y.) and P. L. Hofman. J. Eng. Educ., 52: No. 3, 153-60(Dec. 1961).

Two advanced reactor design and analysis courses given at the Knolls Atomic Power Laboratory are described. The programs emphasize heat transfer, fluid dynamics, neutron physics, and their interrelations as applied to reactor design. One is a two-year program for engineers similar to GE's three-year Advanced Engineering Program. The other is a one-year seminar program offered for the benefit of more experienced engineers. (N.W.R.)

17247 FAST REACTORS: A SOVIET OUTLOOK. Nuclear Eng., 7: 137-41(Apr. 1962).

The general philosophy of fast reactors in the U.S.S.R. is outlined and a brief description is given of the BR-5, the 5-Mw experimental fast reactor. The cooling system utilizing sodium is schematically shown along with fuel element and reactor designs for the sintered plutonium oxide reactor. Future fast reactor development in the U.S.S.R. is discussed. (N.W.R.)

17248 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Gordon Brown and Everett Long (to United Kingdom Atomic Energy Authority). British Patent 893,668. Apr. 11, 1962.

A gas-cooled reactor is designed with a shield disposed between the ducts and the core to ensure that the ducts are exposed only to tolerable radiation rates. The shields comprise layers of boron steel and graphite. (D.L.C.)

17249 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Walter Berndt Carlson, John Welsh Taylor, and John David Dell (to Babcock & Wilcox, Ltd.). British Patent 893,742. Apr. 11, 1962.

A ceramic fuel pellet is designed whose tendency to crack and spall is reduced. The pellet comprises three or four sectors separated by narrow gaps which gradually increase in width toward the center of the pellet. The gaps are to accommodate the thermal expansion of the sectors when the maximum design temperature of the sectors is attained. (D.L.C.)

17250 IMPROVEMENTS IN OR RELATING TO PRESSURE VESSELS. Jack Jones Griffiths and Ronald Scott Challender (to United Kingdom Atomic Energy Authority). British Patent 893,858. Apr. 11, 1962.

A reactor pressure vessel is described which has an access hole for each fuel channel. The vessel comprises a basic part-spherical section, a subsidiary part-spherical section thicker than the basic section and of smaller diameter, and an intermediate section joining the two sections. The subsidiary section is at the top of the vessel when top charging is employed, and it is perforated to provide access holes into the vessel. Dimensions are given for a pressure vessel designed in this way to withstand working pressures up to 300 psi; in comparison, a spherical vessel of the same core space and strengthened in the region of the standpipes up to the thickness of the subsidiary section would withstand only 218 psi. (D.L.C.)

17251 IMPROVEMENTS RELATING TO THE OPERATION OF NUCLEAR REACTORS. (to Stè Ame Cockerill-Ougree). British Patent 893,881. Apr. 18, 1962.

A method is given for improving the utilization of the core of a reactor which uses D_2O as the moderator. In this method, D_2O of commercial purity is used until the core reactivity falls to the minimum possible for reactor operation; the D_2O is then diluted with H_2O to permit further operation. The increase in core life obtained in this way may amount to 20%. (D.L.C.)

17252 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR CONTROLLING THE ACTIVITY OF A REACTOR. Andre Huet. British Patent 893,962. Apr. 18, 1962.

A control apparatus is described which operates entirely inside the reactor and which takes up little space in the inoperative position. The apparatus comprises rods or strips of neutron-absorbing material pivoted at their ends between the inoperative position above the fuel rods and the operative position between the fuel rods. The apparatus may be combined with any device for altering the distances between the fuel rods and is applicable to mobile reactor installations, such as marine installations. (D.L.C.)

17253 FUEL ELEMENT FOR A HETEROGENEOUS NUCLEAR REACTOR. (to Almänna Svenska Elektriska Aktiebolaget). British Patent 893,970. Apr. 18, 1962.

A can for metal oxide fuel slugs is described which need not be fabricated to exact dimensions. The can comprises a tube of stainless steel of thickness 0.08 to 0.16 mm; in operation, the pressure of the reactor coolant forces the can against the fuel slug. (D.L.C.)

17254 DEVICE ALLOWING EMERGENCY DISCHARGE OF FUEL ELEMENTS FROM THE BASE OF A NUCLEAR REACTOR. Sebastien Foglia (to Commissariat à l'Énergie Atomique). British Patent 893,978. Apr. 18, 1962.

A device is designed for the emergency discharge of fuel elements from the base of a vertical channel of a reactor normally discharged from the top. The device comprises a support permanently fixed to the moderator structure at the lower part of the channel and leaving the channel outlet free; and a member disposed across the channel to support the fuel elements and provided with parts for locking on the supports and with at least one zone of weak mechanical resistance so that it can be cut to free the channel outlet. (D.L.C.)

17255 NUCLEAR REACTOR SIMULATOR. Frederic Charles Gerard van Baerle. British Patent 894,002. Apr. 18, 1962.

A reactor simulator is described which is very inexpensive and shows the results in a very illustrative way. The simulator includes a transistor and an indicator connected in a circuit in such a way that the transistor has low thermal stability. A heat source is provided to heat the transistor in a way analogous to the initiation of a nuclear reaction, with control means for adjusting the transistor heating. A model of a reactor may be provided with the screening control knob connected to the adjustable resistor, and the leakage current of the transistor serves as a measure of the nuclear reaction intensity. (D.L.C.)

17256 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS AND A METHOD CONTROLLING THE REACTIVITY THEREOF. Andre Huet. British Patent 894,187. Apr. 18, 1962.

A system for controlling the reactivity of a reactor is given which introduces into the reactor coolant particles of neutron-absorbing materials, e.g., cadmium granules. These particles may be spongy for circulating freely in the coolant or of such density that they gradually accumulate at the bottom of the reactor for withdrawal. The control system is suitable for use in reactors in which the fuel rods are variable in position, such as described in British Patent 857,675. (D.L.C.)

17257 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL ELEMENTS. George Erasmus Darwin and Norman George Worley (to Babcock & Wilcox Ltd.). British Patent 894,193. Apr. 18, 1962.

An end closure is designed for a fuel element comprising a closed can enclosing a fuel body. The end closure comprises a closure member at one end of the can, heat-insulating material between the body and the closure member, and annular spacing means encircling the insulating material to resist compression of the insulating material. The spacing means and the can are locked together by means of projections and recesses. (D.L.C.)

17258 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL ELEMENTS. George Erasmus Darwin and Norman George Worley (to Babcock & Wilcox Ltd.). British Patent 894,194. Apr. 18, 1962.

A reactor fuel element comprising a closed can enclosing a fuel body is designed with an improved end closure. The end closure has a peripheral flange which fits over one end of the fuel body and is butt-welded to the end of the can. The end closure may also be provided with fins. An insulating material may be inserted between the fuel body and the end closure, together with spacing means as described in British Patent 894,193. The advantage of this end closure design is that in the event of a leak through the weld, escape of fission products into the coolant is not delayed and thus leak detection occurs early. (D.L.C.)

17259 BOILING WATER REACTOR. (to U. S. Atomic Energy Commission). British Patent 894,228. Apr. 18, 1962.

A boiling reactor of the natural circulation type is designed in which the frictional pressure drop and fuel burnout due to the formation of vapor slugs near the channel exit are reduced. This reduction is obtained by means of channels divergently tapered in the direction of coolant flow, and means for separating and accumulating steam is provided at the ends of the channels. (D.L.C.)

17260 IMPROVEMENTS IN OR RELATING TO REACTOR PRESSURE VESSELS. George William Sturley (to Babcock & Wilcox Ltd.). British Patent 894,407. Apr. 18, 1962.

A reactor pressure vessel with a group of nozzles projecting into the interior is provided with thermal insulation for ensuring that the welds joining the nozzles to the vessel do not become too hot. The insulation includes a plurality of units, each having an insulating sleeve encircling a nozzle and an insulating flange connected to the sleeve and lining part of the vessel shell around the nozzle. The insulation is of the type described in British Patent 891,353. (D.L.C.)

17261 NUCLEAR REACTOR FUEL EXCHANGE ARRANGEMENTS. (to Allmänna Svenska Elektriska Aktiebolaget). British Patent 894,418. Apr. 18, 1962.

A protection means for gas-cooled reactors is designed which makes it possible to use water shielding on the reactor cover and for the storage of old fuel elements. The protection means comprise a water tank located above the reactor and a water-filled storage chamber; the loading machine comprises a pressure vessel which may be connected in a pressure-tight manner with lead-through bushings in the reactor cover and provided with internal sealing plugs. After the loading machine unloads a fuel element from the reactor, it is conveyed to another bushing for lowering the fuel element into the storage chamber. (D.L.C.)

17262 NUCLEAR FUEL ELEMENT AND METHOD OF PRODUCING SUCH FUEL ELEMENT. (to General Electric Co.). British Patent 894,453. Apr. 18, 1962.

A reactor fuel element utilizing uranium or plutonium compounds of low thermal conductivity is designed which avoids the danger of melting in high power generation at high temperatures. The fuel element comprises outer imperforate layers of cladding contiguous with an inner layer having a plurality of fuel-filled cells, the cells having a length/diameter ratio of 1.0 to 5.0. The fuel element may be in the form of a flat or curved plate. (D.L.C.)

17263 IMPROVEMENTS IN OR RELATING TO SHAPED BODIES COMPOSED OF POROUS MATERIAL, SUCH AS GRAPHITE OR CARBON, AND HAVING A GAS TIGHT AND LIQUID TIGHT SURFACE. (to Siemens-Planiawerke A. G. für Kohlefabrikate). British Patent 894,593. Apr. 26, 1962.

A method is given for making graphite or carbon bodies with impermeable surfaces. The method results in bodies covered with a first layer of at least one carbide of the group Ti, Cr, Mo, Si, and Zr and with a second layer of at least one of the elements Mo, Cr, Ti, Zr, and Si and/or of an electrically conducting combination of one of these elements with N, Be, B, Al, Si, P, or C. Various ways of depositing the first and second layers on the bodies are given. (D.L.C.)

17264 IMPROVEMENTS RELATING TO THE LAYOUT, CONSTRUCTION AND OPERATION OF NUCLEAR REACTORS. Kurt Diebner. British Patent 894,633. Apr. 26, 1962.

A reactor is described which circumvents the disadvantages of homogeneous and heterogeneous reactors by using a "quasi-homogeneous" type of fuel. The fuel is in the form of open-ended hollow structures, preferably Raschig rings, oriented randomly in the reactor; a coolant is arranged to flow around and through the rings to extract heat therefrom. Raschig rings filled with moderator may be mixed with fuel-bearing rings. The advantage of this arrangement over one using balls is that the resistance to coolant flow is much lower. (D.L.C.)

17265 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. John Harper, John George Edwards, Arthur William Shilling, and David William Williams (to United Kingdom Atomic Energy Authority). British Patent 894,641. Apr. 26, 1962.

A reactor fuel element comprising a fuel member enclosed in a protective sheath closed by an end cap is fabricated with two spaced welds sealing the end cap to the sheath to prevent the end cap from resulting in a leak. The first weld is done in the conventional way at the outside contact of the sheath and the end cap, while the second weld is made by forming a recess in either the sheath or end cap, filling the recess with a strip of magnesium alloy, and melting the strip by electric resistance heating. (D.L.C.)

17266 SODIUM DEUTERIUM REACTOR. (to U. S. Atomic Energy Commission). British Patent 894,668. Apr. 26, 1962.

A sodium deuterium reactor is designed which uses a calandria to contain the fuel elements, the high-temperature sodium coolant, the inert barrier gas, and the low-temperature D_2O moderator. A barrier system for separating the coolant and moderator and for thermal insulation therebetween is described in detail. (D.L.C.)

17267 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Herbert Chilvers Knights and Peter Neil Munn (to United Kingdom Atomic Energy Authority). British Patent 894,717. Apr. 26, 1962.

A graphite moderator structure is designed which entails a simple stacking of graphite blocks without spaces therebetween, yet which does not create distortions under irradiation growth. The structure comprises a stack of graphite blocks which has recesses formed in their side faces so that contact between side faces occurs only over narrow contact bands at the ends of the blocks, and centripetal restraint means acting at the planes of the contact bands is provided around the structure. Thus, even under conditions of non-uniform growth of the blocks, the continuity and integrity of the fuel channels are unimpaired. (D.L.C.)

17268 IMPROVEMENTS IN VAPOUR GENERATING PLANT. (to Babcock & Wilcox, Ltd.). British Patent 894,898. Apr. 26, 1962.

A boiler for producing vapor by heating with a hot gas, e.g., from a reactor, is designed for hot gases under pressure. The boiler comprises a cylindrical pressure vessel containing an upper vapor space, a lower vapor generating space, and a vapor-liquid separating drum situated therebetween. The advantages of the boiler are that the equipment can be assembled as a unit and then inserted into the pressure vessel, and that the hot gas, confined to the vapor generating tubes, does not exert pressure on the pressure vessel. (D.L.C.)

17269 IMPROVEMENTS IN OR RELATING TO A NUCLEAR REACTOR AND TO A METHOD OF OPERATING SAME. (to Babcock & Wilcox Co.). British Patent 894,902. Apr. 26, 1962

Reactivity control for pressurized water-cooled thermal reactors can be obtained by employing H_2O-D_2O as the moderator and changing the H/D ratio of the moderator to increase the neutron slowing down power as the reactor core is burned up. One advantage of such reactivity control is that the life of the core is extended owing to the increase in the conversion ratio. (D.L.C.)

17270 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Manfred Siebker (to L & C. Stienmuller G.m.b.H.). British Patent 894,903. Apr. 26, 1962.

A method is described for removing vapor from the reactor coolant in boiling reactors of either homogeneous or heterogeneous type. The method comprises imparting a rotary or helical motion to the coolant within the reactor core so that the vapor is extracted from the coolant by radially inward movement. In the homogeneous reactor with suspended fuel granules, rotary flow is obtained by feeding the coolant tangentially through the outer wall of the cylindrical core vessel. In the heterogeneous reactor, the coolant is passed within the core through pipes having twisted sheet metal guides for imparting helical motion. The method enables the raising of the specific thermal output of boiling reactors. (D.L.C.)

17271 IMPROVEMENTS IN OR RELATING TO POSITION INDICATING APPARATUS. Ronald Hugh Campbell (to United Kingdom Atomic Energy Authority). British Patent 894,972. Apr. 26, 1962.

An apparatus is designed for monitoring the positions of a number of synchronously adjustable reactor control rods. The apparatus comprises a position transmitter for each rod, a receiver, a switch for feeding transmitter signals to the receiver in a cyclically repeated sequence, a servo loop for eliminating the error signal from a difference between the reference position and the position signaled to the receiver, and an alarm operated when the error signal exceeds a predetermined level. An indicator is provided for showing the positions of the members as their positions are scanned by the receiver. (D.L.C.)

17272 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Heinrich Hugo Ludolf Ritz (to C. A. Parsons & Co., Ltd.). British Patent 895,016. Apr. 26, 1962.

A fuel element for graphite-moderated, gas-cooled reactors is designed whose fuel is in plate form and which induces a vortex type of coolant flow for improved heat transfer. The element comprises a plurality of fuel plates held in the coolant channel in a position inclined to the channel axis. Various embodiments of this design are described. (D.L.C.)

17273 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTORS. William Macrae (to C. A. Parsons & Co., Ltd.). British Patent 895,295. May 2, 1962.

A gas-cooled graphite-moderated reactor is designed with storage spaces in the part of its concrete radiation shield lying at the side of the core. Used fuel elements removed from the core may be stored in these spaces until they can be safely transported to a processing plant. Thus, the use of a storage pond with attendant corrosion problems is avoided. (D.L.C.)

17274 IMPROVEMENTS IN AND RELATING TO FUEL HANDLING MECHANISMS FOR FLUID-COOLED HETEROGENEOUS NUCLEAR REACTORS. David John Ingram (to General Electric Co., Ltd.). British Patent 895,356. May 2, 1962.

A charge/discharge mechanism is designed to be used outside the containment vessel of a reactor and thus can be serviced without entering the containment vessel. The mechanism comprises a pressure chamber with storage facilities for irradiated and/or fresh fuel elements and a surrounding containment chamber. Means for sealing the mechanism to the reactor includes a nozzle device. (D.L.C.)

17275 PROCESS FOR PRODUCING NUCLEAR REACTOR FUEL. Max Steenbeck and Wolfgang Schimmel (to Wissenschaftlich-Technisches Buro fur Reaktorbau). U. S. Patent 3,031,390. Apr. 24, 1962.

A process is outlined for preparing slurries of fuel particles in a carrier metal melt, e.g., lead or bismuth. The process comprises forming atomic H from H_2 in an arc and passing the atomic H to the carrier metal carrying fuel granules on its surface, whereby wetting of the fuel granules by the carrier metal is improved. An apparatus for carrying out the process is described. (D.L.C.)

17276 NUCLEAR FUEL ELEMENTS. Noble N. Ida and John J. Mueller (to Martin Marietta Corp.). U. S. Patent 3,031,392. Apr. 24, 1962.

An alloy having improved properties for use as a cladding material for fuel elements consists of 3 to 6 wt % Cr, 0.2 to 1 wt % Ti, 4 to 11 wt % Al, 0.5 to 4 wt % Nb, not more than 0.15 wt % C, and balance Fe. The alloy may also contain up to 3 wt % Mo and up to 4.5 wt % Si for further improvements in its mechanical properties. Comparisons are made between the mechanical properties and thermal neutron absorption cross section of the alloy and those of an Al–Mo–Fe alloy and of 18-8 stainless steel. (D.L.C.)

17277 FUEL ELEMENT FOR NEUTRONIC REACTORS. John T. Stacy, Henry A. Saller, and Stanley W. Porembka, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,032,492. May 1, 1962.

The fuel element consists of a core of uranium dioxide embedded in a binary niobium alloy containing 5 to 10 wt % of titanium and a corrosion-resistant jacket around the core. (AEC)

17278 SOLID GAS SUSPENSION NUCLEAR FUEL ASSEMBLY. D. C. Schluderberg and J. W. Ryon (to U. S. Atomic Energy Commission). U. S. Patent 3,033,773. May 8, 1962.

A fuel assembly is designed for use in a gas-suspension cooled nuclear fuel reactor. The coolant fluid is an inert gas such as nitrogen or helium with particles such as carbon suspended therein. The fuel assembly is contained within an elongated pressure vessel extending down into the reactor. The fuel portion is at the lower end of the vessel and is constructed of cylindrical segments through which the coolant passes. Turbulence promotors within the passageways maintain the particles in agitation to increase its ability to transfer heat away from the outer walls. Shielding sections and alternating passageways above the fueled portion limit the escape of radiation out of the top of the vessel. (AEC)

17279 CONTROL SYSTEM FOR NEUTRONIC REACTORS. Frederick E. Crever (to U. S. Atomic Energy Commission). U. S. Patent 3,033,774. May 8, 1962.

A slow-acting shim rod for control of major variations in reactor neutron flux and a fast-acting control rod to correct minor flux variations are employed to provide a sensitive, accurate control system. The fast-acting rod is responsive to an error signal which is produced by changes in the neutron flux from a predetermined optimum level. When the fast rod is thus actuated in a given direction, means is provided to actuate the slow-moving rod in that direction to return the fast rod to a position near the midpoint of its control range. (AEC)

17280 DISCHARGE VALVE FOR GRANULAR MATERIAL. L. D. Stoughton and S. T. Robinson (to U. S. Atomic Energy Commission). U. S. Patent 3,034,689. May 15, 1962.

A gravity-fed dispenser or valve is designed for discharging the fueled spherical elements used in a pebble bed reactor. The dispenser consists of an axially movable tube terminating under a hood having side walls with openings. When the tube is moved so that its top edge is above the tops of the side openings the elements will not flow. As the tube is moved downwardly, the elements flow into the hood through the side openings and over the top edge into the tube at an increasing rate as the tube is lowered further. The tube is spaced at all times from the hood and side walls a distance greater than the diameter of the largest element to prevent damaging of the elements when the dispenser is closed to flow. (AEC)

17281 REACTOR HAVING $NaK-UO_2$ SLURRY HELICALLY POSITIONED IN A GRAPHITE MODERATOR. Max B. Rodin and Joseph C. Carter (to U. S. Atomic Energy Commission). U. S. Patent 3,034,978. May 15, 1962.

A reactor utilizing 20% enriched uranium consists of a central graphite island in cylindrical form, with a spiral coil of tubing fitting against the central island. An external graphite moderator is placed around the central island and coil. A slurry of uranium dioxide dispersed in alkali metal passes through the coil to transfer heat externally to the reactor. There are also conventional controls for regulating the nuclear reaction. (AEC)

17282 TRIPPING CIRCUIT. G. W. Lees and E. D. McCormick (to U. S. Atomic Energy Commission). U. S. Patent 3,035,996. May 22, 1962.

A tripping circuit employing a magnetic amplifier for tripping a reactor in response to power level, period, or instrument failure is described. A reference winding and signal winding are wound in opposite directions on the core. Current from an ion chamber passes through both windings. If the current increases at too fast a rate, a shunt circuit bypasses one of the windings and the amplifier output reverses polarity. (AEC)

17283 FUEL ELEMENT FOR NUCLEAR REACTORS. Reinhold J. Barchet (to Martin Marietta Corp.). U. S. Patent 3,031,388. Apr. 24, 1962.

A pressurized, light-water moderated and cooled reactor is designed which is relatively small and lightweight and which can be readily transported from the point of manufacture to the site of operation. The core comprises an assembly of fuel element bundles, and each tubular fuel element has its ends flared and fluted to effect the desired flow distribution. (D.L.C.)

Power Reactors

17284 (APAE-115(Vol.I)) BWR REFERENCE DESIGN FOR PL-3. (Alco Products, Inc., Schenectady, N. Y.). Feb. 28, 1962. Contract AT(30-1)-2900. 200p.

The natural circulation, direct cycle, boiling water reactor reference design presented is the alternate to the pressurized-water reactor preferred preliminary design developed under Phase I of the PL-3 contract. Plant design criteria, summary of plant selection, plant description, reactor and primary system description, thermal and hydraulic analysis, nuclear analysis, control and instrumentation description, shielding description, auxiliary systems, power plant equipment, waste disposal, buildings and tunnels, services, operation and maintenance, logistics, erection, cost information, and training program outline are given. (auth)

17285 (APAE-115(Vol.II)) PWR PRELIMINARY DESIGN FOR PL-3. (Alco Products, Inc., Schenectady, N. Y.). Feb. 28, 1962. Contract AT(30-1)-2900. 236p.

The pressurized water reactor preliminary design, the preferred design developed under Phase I of the PL-3 contract, is presented. Plant design criteria, summary of plant selection, plant description, reactor and primary system description, thermal and hydraulic analysis, nuclear analysis, control and instrumentation description, shielding description, auxiliary systems, power plant equipment, waste disposal, buildings and tunnels, services, operation and maintenance, logistics, erection, cost information, and a training program outline are given. (auth)

17286 (BAW-1230(Pt.II)) SPECTRAL SHIFT CONTROL REACTOR BASIC PHYSICS PROGRAM–THEORETICAL ANALYSIS. PART II. BPG COMPUTER PROGRAM

REPORT. G. A. G. de Coulon, L. D. Gates, and W. R. Worley (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). [Jan. 1962]. Contract AT(30-1)-2602. 89p.

The BPG code was written to compute the criticality of reactors using all kinds of moderators, specifically including mixtures of H_2O and D_2O. Since slowing down with hydrogen moderator is susceptible to exact calculation, and since the Fermi age equation accurately treats heavy moderators such as carbon, the important innovations in this code deal with the transition from light to heavy scatter, and particularly with the treatment of moderation by deuterium. Included in the description of the code are derivation of the equations, physical data for the calculations, input and output format, and general operating conditions for use with the Burroughs 205 computer. (M.C.G.)

17287 (CNI-102) PROPRIETÀ MECCANICHE E CHIMICHE DI MATERIALI DI GUAINA PER ELEMENTI DI COMBUSTIBILE DI UN REATTORE REFFREDDATO A GAS, CON PARTICOLARE RIGUARDO ALL'IMPIEGO DI CO_2. (Mechanical and Chemical Properties of Canning Materials for Fuel Elements of a Gas-Cooled Reactor, with Particular Attention to the Use of CO_2). S. Pizzini (Italy. Comitato Nazionale per l'Energia Nucleare. Centro di Studi Nucleari, Ispra). Jan. 1962. 69p.

The mechanical and chemical properties of possible canning materials for gas-cooled reactors are discussed. An introduction to the study of corrosion problems of new proposed alloys in the field of high-temperature technology is given. Only those materials are taken into account, whose nuclear properties are considered to be satisfactory. (auth)

17288 (DC-52-4-37) A METAL SCREEN, FOLDED, WATER MODERATED AIR CYCLE REACTOR. W. B. Thomson (General Electric Co. Aircraft Nuclear Propulsion Project, Cincinnati). Apr. 17, 1952. Contract [AT (11-1)-171]. 11p.

An air-cycle reactor in which the fuel elements are composed of screens built of temperature-resistant metal wire containing fissionable material is discussed. The basic idea was to utilize the high heat-transfer coefficients obtainable when heating flowing gases with wires, without incurring large pressure losses. About 5 to 10 screens appeared to provide a satisfactory bed thickness. An illustration of the type of reactor to be expected from this design approach is given, together with some of the power plant characteristics. (M.C.G.)

17289 (DC-55-11-25) HTRE NO. 1 PROJECT 100 MAINTENANCE MANUAL—REACTOR ASSEMBLY AND AUXILIARY SYSTEMS. J. B. Crabbe, ed. (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 4, 1955. Contract AT(11-1)-171. 88p.

A compilation is presented of information that may be required to maintain the HTRE-1 reactor assembly and auxiliary systems. Core and plug drain system, actuator cooling system, and general wiring and wiring harness are covered. (M.C.G.)

17290 (DP-715) HEAVY WATER MODERATED POWER REACTORS. Progress Report, February 1962. R. R. Hood, comp. (Du Pont de Nemours (E. I.) & Co. Explosives Dept., Wilmington, Del.). Mar. 1962. Contract AT(07-2)-1. 29p.

Final preparations were made for the initial approach to criticality in the Heavy Water Components Test Reactor (HWCTR). Fabrication was completed on the first fifteen pairs of thin-walled uranium tubes for HWCTR irradiation tests. Work continued on the fabrication by mechanical compaction of Zircaloy-clad tubes of uranium oxide for irradiation tests. A 19-rod test section cooled by forced flow of boiling water at 1000 psia was tested to destruction by heat transfer burnout; the burnout data were in reasonable agreement with previous data for similar test sections. (auth)

17291 (EURAEC-222) AN ADVANCED RESEARCH PROGRAM ON THE APPLICATION OF STEAM—WATER SPRAY TO THE COOLING OF LIGHT WATER REACTORS. CAN-2 Quarterly Progress Report No. 2, October 1 to December 31, 1961. (Centro Informazioni Studi Esperienze, Milan). Jan. 15, 1962. Work performed under United States—Euratom Joint Research and Development Program. Contract 060-61-7-RDI. 12p. (CISE-R-51)

The reassembling of the heat transfer experimental facility at the Piacenza Power Station was completed, as well as the preliminary tests. A complete set of experiments was carried out at constant pressure (1,000 psi) with a test element 0.52 cm ID. Heat transfer coefficient was measured both at the inlet and at the outlet of the heated section. New codes for data elaboration were prepared. Hydrodynamics experiments were performed with the argon—water mixture with four different test sections (perspex, round, 1.5 cm ID; perspex, annular, 1.5 cm ID and 2.5 cm OD; PVC, round 1.5 cm ID; and stainless steel, round, 2.5 cm ID). Several experiments were also performed with ethyl alcohol in the PVC round section. The loop was disassembled. Corrosion tests are in progress for investigating the behavior of Zircaloy-2 specimens during long exposures: some specimens reached about 2,500 hours of exposure. The assembling of the second corrosion loop was started. (auth)

17292 (FXM-428) FIREBALL HYDRODYNAMICS. T. Tucker (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). May 27, 1953. Contract [AT(11-1)-229]. 4p.

A hydrodynamic analysis was made of the Fireball reactor. Even though the negative temperature coefficient tends to make the Fireball stable, it may be desirable to limit ΔK to around 0.005 to avoid high pressure surges. It is hoped that variations due to change in flow patterns, gas bubbles, and power density can be reduced by proper design. (auth)

17293 (GA-2861) 40-MW(E) PROTOTYPE HIGH-TEMPERATURE GAS-COOLED REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending December 31, 1961. (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Contract AT(04-3)-324. 121p.

Development is described on reactor core materials, reactor core and reflector design, reactor equipment, and auxiliary plant systems. Details of work in experimental reactor physics are also included and a list of reports issued from Oct. 1, 1961 to Dec. 31, 1961 is presented. (J.R.D.)

17294 (GAMD-1375) DESIGN CRITERION OF PLENUM TO REFLECTOR BLOCK SEAL FOR HTGR REACTOR VESSEL. W. A. Kalk (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Apr. 20, 1960. Contract AT(04-3)-314. 16p.

A survey was made of sealing methods and their adaptability to the requirements of the plenum reflector seal on the HTGR reactor vessel. A leak rate through the seal of 43.8 pounds per hour of helium was established as an acceptable leak. Lap joints of steel to graphite or graphite to graphite with a 100 RMS surface finish met the required leak rate and two basic concepts of this type of seal are illustrated. (auth)

17295 (GAMD-2660) CRITICAL REVIEW OF THE METHODS FOR TREATING GEOMETRIC EFFECTS IN HTGR ANNUAL RESONANCE INTEGRAL CALCULATIONS. J. B. Sampson (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Nov. 29, 1961. Contract AT(04-3)-314. 20p.

The basis of methods suggested by L. Nordheim for calculating resonance integrals in the HTGR annuli is described. It is shown that the mean chord length so determined for the annulus is correct in two limiting cases. Several other approximations occur which may overestimate the surface component of the resonance integral by about 5%, or the total resonance integral by a few per cent. No other reasons for inaccuracy are evident. (auth)

17296 (GEAP-3771-2) HIGH PERFORMANCE UO$_2$ PROGRAM. Quarterly Progress Report No. 2, July–September 1961. B. Weidenbaum (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Oct. 1, 1961. Work performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 49p. (EURAEC-170)

Two fuel rods were prepared for irradiation. Steady-state operating conditions of the in-pile loop were modified to reflect the lower axial peaking factor of 1.55. A trap was designed and tested for removal of particulate matter from the loop. Burnout heat flux limits for UO$_2$ were determined. Physical analysis to establish fuel enrichments for test assemblies was completed. (M.C.G.)

17297 (LAMS-2681) QUARTERLY STATUS REPORT ON LAMPRE PROGRAM FOR PERIOD ENDING FEBRUARY 20, 1962. (Los Alamos Scientific Lab., N. Mex.). Mar. 1962. Contract W-7405-Eng-36. 21p.

LAMPRE I. The reactor operation is discussed. A malfunction in the shim operation was found and corrective measures taken. The core reloadings and other reactor modifications are described. The results of a gamma scanning of a fuel capsule are given. Fuel and Container Development. The properties and behavior of the Core I and the materials developed for Core II are described. Corrosion tests were carried out on pure Ta containers with molten Pu–Ce–Co alloys at 750 to 900°C, and the results indicate that Pu–Ce–Co alloys containing less than 5 g/cm^3 Pu should be acceptable for use in LAMPRE. The crystal structures of Pu$_3$Co and the most Ce-rich compound in the Ce–Co system, Ce$_{24}$Co$_{11}$, were determined. Results are given for a search for ternary eutectic alloys of high U content and for an investigation of the eutectic temperatures of several binary U alloys. Corrosive tests on ceramic materials with molten Mn–Pu–U and Mn–U alloys at 900 to 1000°C are summarized. Critical Experiments. Specifications and status are given for PBX. Core Test Facility. The status of the Core Test Facility design is given. The sodium systems, heat dump system, and disassembly cell mockup are discussed. Fuel Reprocessing. Results are presented of runs on the separation of plutonium from fission products by volatilization and liquation. (D.L.C.)

17298 (ORNL-TM-191) EFFECT OF REDUCED U-235 PRICE ON FUEL CYCLE COSTS. L. L. Bennett (Oak Ridge National Lab., Tenn.). Mar. 7, 1962. Contract [W-7405-Eng-26]. 69p.

A study was made to determine the effect of changes in natural uranium cost and in separative work charges on fuel cycle costs in nuclear power plants. Reactors considered were a Dresden-type boiling water reactor (BWR) and a Yankee-type pressurized water reactor (PWR), with net power ratings of 100, 300, and 500 Mwe. Fuel cycle costs were calculated for these reactors, using either enriched uranium or U^{235}-thorium as the fuel material. The price schedule for uranium was based on a feed material cost of \$15/kg uranium as UF$_6$ and separative work costs of \$30/kg uranium (Schedule B) and \$20/kg uranium (Schedule C). The present AEC price schedule for enriched uranium was also used for purposes of a reference case. The results indicate that a reduction in present enriched uranium price to that given by Schedule B would reduce fuel cycle costs for the BWR plants by 0.4 to 0.5 mill/kwh for the enriched-uranium cycle, and 0.4 to 0.7 mill/kwh for the thorium cycle. Reductions in fuel cycle costs for the PWR plants were 0.5 to 0.7 and 0.4 to 0.75 mill/kwh, respectively, for the same situations. (auth)

17299 (SRO-66) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT [FOR] MARCH 1962. (Savannah River Operations Office, AEC). 18p.

Results of cold tests on a ball-type adapter valve showed a leakage rate below the maximum permissible of 300 cc/hr. Development is summarized on sintered Al products, pressure tubes, header and feeder piping fluid dynamics, Zr technology, and Be irradiation. Research and development is also reported on Heavy Water Components Test Reactor, Vallecitos Boiling Water Reactor, and the Carolinas-Virginia Tube Reactor. (J.R.D.)

17300 (WCAP-4123) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., CVTR PROJECT MONTHLY PROGRESS REPORT, MARCH 1962. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Contract AT(30-1)-2289. 15p.

Tests of three v-notched, as-extruded tube specimens at 275°F did not show appreciable temperature effects. Completion is reported of preliminary designs concerning disassembly equipment for sectioning fuel and pressure tube components. The fuel rods containing thermal expansion markers were assembled, welded and x rayed prior to being corrosion tested. (J.R.D.)

17301 AUTOMATION AND CONTROL IN NUCLEAR POWER PLANTS IN FRANCE. M. F. Bourdillat. Bull. soc. franç électriciens, (8), 2: 677-96(Dec. 1961). (In French)

Automation and control in the Chinon nuclear power plants constitute assemblies more developed than corresponding installation in classical thermal power plants. Automation and control of these power plants are described and their evolution is traced. (J.S.R.)

17302 STABILITY PROBLEMS IN A GAS–GRAPHITE REACTOR USING SELF-REGULATING NEUTRON ABSORBERS. A. Facchini (LRSR, Milan and CESNEF, Milan), A. Garroni, and V. Gervasio. Energia nucleare (Milan), 9: 21-35(Jan. 1962). (In English)

The use of self regulating neutron absorbers as a control device in a graphite-gas reactor, to counteract xenon and positive temperature coefficient effects, requires a preliminary investigation of spatial dynamics. A mathematical model suitable for this purpose is introduced, and some applications concerned with the system stability analysis are presented. The equations involved were solved by an analog computer. (auth)

17303 FORGED COMPONENTS FOR THE SENN VESSEL. A. Bartocci and E. Marianeschi (Terni Co., Italy). Nuclear Eng., 7: 146-8(Apr. 1962).

The 180-ton pressure vessel for Garigliano was fabricated from forged components in preference to welded plate. The vessel is described along with the forging process and the qualitative results. The principal advantages of using forged components are elimination of longitudinal welded joints, 40% reduction of total welding length, greater construction accuracy, and simpler design. The advantages more than compensate for the 10% cost difference in using forged components instead of welded plates. (N.W.R.)

17304 NUCLEAR SUPERHEATER FOR BOILING WATER REACTOR. R. J. Holl, R. W. Klecker, and C. B. Graham (to U. S. Atomic Energy Commission). U. S. Patent 3,034,977. May 15, 1962.

A description is given of a boiling water reactor having a superheating region integral with the core. The core consists essentially of an annular boiling region surrounding an inner superheating region. Both regions contain fuel elements and are separated by a cylindrical wall, perforations being provided in the lower portion of the cylindrical wall to permit circulation of a common water moderator between the two regions. The superheater region comprises a plurality of tubular fuel assemblies through which the steam emanating from the boiling region passes to the steam outlet. Each superheater fuel assembly has an outer double-walled cylinder, the double walls being concentrically spaced and connected together at their upper ends but open at the bottom to provide for differential thermal expansion of the inner and outer walls. Gas is entrapped in the annulus between the walls which acts as an insulating space between the fissionable material inside and the moderator outside. (AEC)

17305 REFLECTOR CONTROL OF A BOILING-WATER REACTOR. Michael Treshow (to U. S. Atomic Energy Commission). U. S. Patent 3,035,993. May 22, 1962.

A line connecting the reactor with a spent steam condenser contains a valve set to open when the pressure in the reactor exceeds a predetermined value and an orifice on the upstream side of the valve. Another line connects the reflector with this line between the orifice and the valve. An excess steam pressure causes the valve to open and the flow of steam through the line draws water out of the reflector. Provision is also made for adding water to the reflector when the steam pressure drops. (AEC)

Research Reactors

17306 (AECL-1443) THE CANADA-INDIA REACTOR. (Shawinigan Engineering Co. Ltd., Montreal and Atomic Energy of Canada Ltd., Chalk River, Ont.). Dec. 1960. 295p.

The design of the Canada-India Reactor is described. Reactor physics, the control and safety system, the primary coolant system, and air cooling and ventilation are discussed. The commissioning plan is included. (M.C.G.)

17307 (JAERI-1022) PERFORMANCE TEST OF THE JRR-2 COOLING TOWER. Sadamu Sawai (Japan Atomic Energy Research Inst., Tokyo). Feb. 1962. 13p.

Performance testing the JRR-2 cooling tower is described. The test was made to decide whether this cooling tower has the designed cooling capacity at the specified condition. As the temperatures of atmosphere and of water are not expected to be unchangeable throughout the year, the cooling tower test could hardly be made at the specified or designed condition. Studies were made of any factors which affect the cooling tower characteristics. The test was made keeping water and air flows at the designed rates, and the number of transfer units of the cooling tower was obtained. Then, the evaluation of the cooling tower capacity was made by comparing this value with the design value. The value of $k_g \cdot S$, which shows the cooling tower efficiency, is also given. (auth)

17308 (JAERI-5008) REPORT ON CONSTRUCTION OF THE HOUSING, BUILDING AND AUXILIARY FACILITIES FOR THE JRR-3. (Japan Atomic Energy Research Inst., Tokyo). Mar. 1962. 107p.

Details of design and development of the JRR-3 facilities are presented. This is the first domestically developed reactor and is a natural U, heavy-water moderated research facility with a thermal output of 10 Mw. (J.R.D.)

17309 (NP-11454) FINAL SAFEGUARDS REPORT, ARMED FORCES RADIOBIOLOGY RESEARCH INSTITUTE. REVISED EDITION. (General Atomic Div. General Dynamics Corp., San Diego, Calif. and Holmes and Narver, Inc., Los Angeles). Mar. 1962. 512p.

A safeguards analysis was made of the DASA (Defense Atomic Support Agency)—TRIGA Mark F Reactor. Information and evaluations are presented relating to the site at the Armed Forces Radiobiology Research Institute, the design and performance of the reactor, the design of the Institute's facilities, the organization of the Institute, and the policies relating to the control of the reactor which demonstrate that the Institute can be licensed for operation of the DASA-TRIGA Mark F Reactor with an assurance that there will not be an undue hazard to the health and safety of the Institute's staff or the public. (M.C.G.)

17310 (ORNL-TM-178) A STUDY OF THE SHIELD OF THE UNIVERSITY OF ILLINOIS TRIGA MARK II RESEARCH REACTOR. T. V. Blosser, R. M. Freestone, Jr., and J. M. Miller (Oak Ridge National Lab., Tenn.). Apr. 23, 1962. Contract W-7405-Eng-26. 33p.

Detailed measurements were made of the fast-neutron and gamma dose rates and the thermal-neutron fluxes existing at the surfaces of the biological shield of the University of Illinois TRIGA Mark II Research Reactor. Dose rates and fluxes were found to be extremely low. A comparison was made by means of threshold foil techniques between the fast-neutron flux in a beam hole of the reactor during steady-state operation at 1 kw and during a nominal 250 Mw, 30 msec pulse produced by rapid insertion of ~ two dollars of excess reactivity. The flux over the duration of the pulse was approximately four times that for steady-state operation for 1 hr at 1 kw. Fast-neutron dose rates and thermal-neutron fluxes were measured at each of the four beam ports of the reactor at operating powers of 0, 1, and 5 watts. Some gamma dose rate data was also obtained at 0 and 1 watt. The threshold foil technique used is described. (auth)

17311 (SCR-480) NEUTRON FLUX AND SPECTRA MEASUREMENTS IN THE VOID TANK OF THE TRIGA MARK-F REACTOR. K. C. Humphreys (Sandia Corp., Albuquerque, N. Mex.). Feb. 1962. Contract [AT(29-1)-789]. 18p.

Neutron flux and spectra measurements were made in the void tank irradiation chamber of the TRIGA Mark-F reactor in support of radiation effects studies in that facility. Threshold foils were used for the measurements. Measurements were made with three lead-shielding thicknesses; zero, 3, and 4 inches between the reactor core shroud and the points of measurements. (auth)

17312 MEASUREMENT OF THE CONCENTRATION OF Ar^{41} IN THE WATER OF A SWIMMING POOL REACTOR AND OF ITS ESCAPE VELOCITY INTO THE SURROUNDING AIR. S. Todisco and A. Franceschini (SORIN, Saluggia, Italy). Minerva nucleare, 5: 319-23(Dec. 1961). (In Italian)

Studies were performed to determine approximately the concentration of Ar^{41} in the air of a pool reactor. The following factors were investigated: (a) the rate of escape of

Ar^{41} from the water into the air at +20°C; and (b) the concentration of Ar^{41} in the water of the reactor. The value for the concentration of Ar^{41} in the room containing the reactor was about 1×10^{-9} c/m^3 with 1 Mw and a rate of circulation of the air of 40,000 m^3/hr. (auth)

17313 FAST PNEUMATIC TRANSFER TUBE FOR IRRADIATION OF SPECIMENS IN A REACTOR. E. C. Campbell and P. F. Fettweis (Centre d'Etude de l'Energie Nucléaire, Mol, Belg.). Nuclear Instr. & Methods, 14: 272-8(Jan. 1962). (In French)

A fast pneumatic transfer tube installed at the BR1-reactor is described. It was used mainly for the study of isomeric nuclear states. The transfer time from the center of the reactor (thermal neutron flux 10^{12} n/cm^2) to a NaI(Tl) scintillation counter is about 0.1 s. States with decay times as short as 0.02 s can be studied. (auth)

SPACE APPLICATIONS AND TECHNOLOGY

17314 (AD-266439) ENERGY CONVERSION INCLUDING MAGNETOAERODYNAMIC STUDIES AND THERMIONIC CONVERTERS. ELECTRICAL PROPULSION AND ELECTRICAL ENERGY CONVERSION INVESTIGATIONS. Semiannual Technical Report, January 1–June 30, 1961. Wallis Grabowsky (Aerospace Corp., El Segundo, Calif.). Contract AF04(647)-594. 19p. (TDR-594(1201-03)TR1(Pt.I))

Two possible methods of measuring arc jet plasma were investigated. The steady-state arc method leads to erroneous results due to deposits on the walls of the plasma container. The possibility of measuring the decay time of the plasma also was investigated. The method requires a switching on the order of 10^{-10} sec for a 1-mho/cm plasma. The exploded wire propulsion device was set up and instrumented. Closed-cycle magnetohydrodynamic vortex generator studies showed that the specific power of the system is greater than that of a conventional turbogenerator for power levels on the order of 50 kw and greater. Possible containing and insulating materials, as well as working fluids, were investigated and feasible combinations obtained. Preliminary experiments were designed to evaluate the proposed configurations. (auth)

17315 (JPLAI-LS-392) ASTRONAUTICS INFORMATION. THERMIONIC AND THERMOELECTRIC CONVERSION SYSTEMS. Edda Barber, comp. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Mar. 1962. Contract NAS-7-100. 53p.

A bibliography of 292 references with abstracts is presented. A few of the references deal with magnetohydrodynamic converters. (D.L.C.)

17316 (NASA-TN-D-414) INSTRUMENTATION OF THE IONOSPHERE DIRECT MEASUREMENTS SATELLITE (EXPLORER VIII). R. E. Bourdeau, J. L. Donley, and E. C. Whipple, Jr. (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). Apr. 1962. 34p.

A description is given of the ionosphere direct measurements of satellite Explorer VIII, with emphasis on the physics of the experiments designed to measure electron density (r-f impedance probe), electron temperature (electron temperature probe), positive ion concentration (ion current monitor), and ion mass (retarding potential probe). Experiments were also performed which measured the momentum, energy, and spatial distribution of dust particles. Experimental data presented are typical of that which has been processed to date. The methods used by systems engineers to fulfill the special requirements imposed by the scientific experiments upon the over-all satellite design are described, and data such as the satellite's thermal and spin-decay history are reported. Of particular interest to spacecraft technologists concerned with the influence of the earth's magnetic field upon satellite orientation are the measurements on the effects of the potential differences at various points on the satellite surface. Finally, a new method for determining satellite aspect is introduced. (auth)

17317 (NP-11476) ASTRONAUTICS INFORMATION. ABSTRACTS, VOL. V, NO. 3. Abstracts 5,201–5,330. B. J. Hardgrove and F. L. Warren, comps. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Mar. 1962. Contract NAS 7-100. 52p.

Abstracts of astronautics information covering the period March 1962 are presented. The 129 abstracts cover the subject of spaceflight and applicable data and techniques. Author, subject, and source indexes are included. (M.C.G.)

17318 (NP-11493) ASTRONAUTICS INFORMATION. OPEN LITERATURE SURVEY VOL. V, NO. 3. ENTRIES 50,418–50,669. E. M. Carringer, M. G. Hoppe, and B. H. Nichols, comps. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Mar. 1962. Contract NAS 7-100. 49p.

A survey of the open literature concerning spaceflight and to applicable data and techniques is presented for March 1962. Areas being reported by other information agencies are in most cases excluded. (J.R.D.)

17319 (NP-11568) PUBLICATIONS OF THE JET PROPULSION LABORATORY, JULY 1960 THROUGH JUNE 1961. Bibliography No. 39-2. D. K. Walsh and R. J. Sippel (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Dec. 29, 1961. Contract NASw-6. 63p.

A bibliography of reports released by the Jet Propulsion Lab. in July 1960 through June 1961 is given with appended abstracts. The bibliography includes technical reports, progress reports, summaries, astronautics information, etc. (D.L.C.)

17320 (PPL-116) THE ELECTROMAGNETIC PINCH EFFECT FOR SPACE PROPULSION. Alfred E. Kunen and William McIlroy (Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.). Aug. 1959. Contracts [AF49(638)-552 and Nonr-285100]. 35p. (AD-266981)

The phenomenon of the electromagnetic pinch effect is used to accelerate ionized gases for space propulsion. Electrical energy, initially stored in capacitors, is discharged across two nozzle shaped electrodes wherein the radial pinch is converted to axial motion of the effected gases instead of confinement at the axis. The gas dynamics of a pinch using the hydrodynamical model of a magnetic piston driving a shock wave is combined with the electrodynamics of the circuit to calculate the discharge behavior. Experiments on three different electrode designs are discussed and results compared with calculated values. Results are applied to one particular space propulsion system consisting of a nuclear energy source, a space radiator, a turbine-generator, capacitor, and a pinch tube. The specific mission analyzed is a one-way unmanned flight to a Mars orbit, starting from an Earth orbit. (auth)

17321 MEASUREMENTS ON AN EXPERIMENTAL INDUCTION PLASMA ACCELERATOR. David B. Miller (Univ. of Michigan, Ann Arbor). ARS (Am. Rocket Soc.) J., 32: 549-52(Apr. 1962).

An experimental arrangement is described which electromagnetically generates and accelerates ionized gas by inductive coupling between the circuit and the gas. Measurements are made of energy coupled from the circuit to the plasma and of energy, momentum, and velocity of the accelerated gas. Energy on the order of 20 to 40 j is transferred to the plasma; this represents about 5 to 10% of the energy available for transfer, and $\frac{1}{3}$ to $\frac{1}{2}$ of this appears as energy of directed motion of the gas. The gas velocities measured 10 cm beyond the acceleration coil are in the range between 0.5×10^4 and 1.5×10^4m/sec, whereas the corresponding momenta are from 2 to 11 g-cm/sec-cm^2 of flow. High speed photographs of the radial compression of the plasma within the coil indicate that this radial compression is influential in determining the ultimate operating characteristics of this type of accelerator. Suggestions are made concerning improvement of efficiency. (auth)

17322 JOULE CYCLE FOR SPACE POWER. Albert G. Hodgson (Martin-Marietta Corp., Denver). ARS (Am. Rocket Soc.) J., 32: 634-5(Apr. 1962).

The Joule cycle combines the advantages of the Stirling cycle and the Rankine cycle for space power systems. For long term missions a Joule engine will convert solar or nuclear energy to shaft power with a lighter system weight than the Rankine cycle and without the power limitation of the Stirling cycle. For short term missions the Joule cycle, using hydrogen ice as a heat sink, yields a more efficient system than the hydrogen expansion engine. (auth)

17323 ADVANCES IN THE ASTRONAUTICAL SCIENCES. VOLUME 6. Proceedings of the Sixth Annual Meeting of the American Astronautical Society, New York City, January 18-21, 1960. New York, The Macmillan Company, 1961. 967p.

A total of 57 papers are presented on space communications, propulsion, guidance and control, space medicine and astrobiology, space flight mechanics, space vehicle design, re-entry, applications of astronautical systems, and space physics. Separate abstracts were prepared for seven of the papers, while four were previously abstracted in NSA. (D.L.C.)

17324 SPACE MISSIONS FOR ION PROPULSION SYSTEMS. Ernst Stuhlinger (Army Ballistic Missile Agency, Huntsville, Ala.). p.67-72 of "Advances in the Astronautical Sciences. Volume 6." New York, The Macmillan Company, 1961.

Ion propulsion systems are distinguished by low thrust, long propulsion times, high exhaust velocities, and very low propellant consumption. These characteristics make ion propulsion systems useful for a number of space missions. It is anticipated that ion propulsion will find application on low-flying satellites, as an attitude control and correction system of satellites which must maintain precise orbit parameters, for the transfer of heavy loads from low to high satellite orbits, in freight ferry systems between satellite orbits and the Moon, or manned space vehicles to Mars and Venus, and on probes to more distant planets. The parameters of the ion propulsion systems are optimized individually for each of these missions. Preliminary design and performance data are presented for vehicles suited for these seven missions. Calculations were based on the assumption that techniques which appear feasible from present laboratory studies will be available for space operations within a few years. Special problem areas are pointed out in which a concentrated research and development effort is required. (auth)

17325 APPLICATION OF THE NUCLEAR ROCKET ENGINE FOR SPACE PROPULSION. A. H. Flagg, H. S. McQueen, and C. H. Trent (Aerojet-General Corp., Azusa, Calif.). p.91-109 of "Advances in the Astronautical Sciences. Volume 6." New York, The Macmillan Company, 1961.

Analyses of various trajectories for flight from Earth and/or Earth orbit to the near planets are presented with regard to the effects of propellant-fraction propulsion system specific impulse and engine thrust-to-gross-weight ratio. These analyses conclude that thrust-to-weight ratios of 0.1 to 0.5 are to be desired from the standpoint of propellant economy. The nuclear rocket can be shown to be quite applicable for propelling vehicles for interplanetary flight either starting as an Earth-launched vehicle or from a standby Earth orbit. Vehicle configurations are shown for Martian flight and special engine details indigenous to space flight are discussed. (auth)

17326 STRAIGHT-LINE FLIGHT TO MARS. T. C. Tsu (Westinghouse Electric Corp., Pittsburgh). p.120-30 of "Advances in the Astronautical Sciences. Volume 6." New York, The Macmillan Company, 1961.

Elementary mechanics teaches that an object moves in a straight line at a uniform speed if no net force acts on it. Therefore, if a space ship is propelled (after its escape from earth) with a thrust that exactly cancels the solar gravitational force at all times, it will travel along a straight line. It is shown with a few simplifying assumptions that if the ship is propelled by a solar sail, and if the sail material has a specific gravity of unity, the sail must be thinner than 0.00015 cm (0.06 mil). If the ship is propelled by an electric powerplant ejecting a propellant at a constant speed during the flight, the powerplant must have a specific mass less than 4.8 kg/kw. If, however, the powerplant is operated at constant power with variable propellant speed, then its specific mass must be less than 16.8 kg/kw. The flight schedule with a powerplant of 5.25 kg/kw and an efficiency of conversion (from electric energy to propellant kinetic energy) of 70 per cent is calculated in some detail. The trip to Mars takes 67 days for the straight-line portion of the flight, or about 100 days including the time required for making escape and approach maneuvers. (auth)

17327 NUCLEAR POWER PLANTS FOR SPACE-VEHICLE APPLICATION. Sherman Naymark (General Electric Co., San Jose, Calif.). p.643-58 of "Advances in the Astronautical Sciences. Volume 6." New York, The Macmillan Company, 1961.

A primary requirement for satellites and space vehicles is an auxiliary electrical power source characterized by low specific weight per unit of power output, long life, compactness, self-contained, design, high reliability, and the need for little or no maintenance. Depending upon the application, the power range of interest extends from a few watts to tens of kilowatts for auxiliary powers. As vehicle technology progresses, this auxiliary power source may be extended in power rating to provide additional electrical energy for low-thrust, long-endurance, secondary propulsion devices such as ion accelerators, while the vehicle is in flight. Preliminary examination of various types of power sources brings an early realization of two basically important points: (1) The vehicle and powerplant designs are intimately dependent upon each other and, therefore, require a parallel design and development effort. (2) The development period of these powerplants may be of equal length to the development time of the vehicles. Consequently, it is imperative that a proper effort be directed to the powerplants if they are to be available when the vehicle is ready for test flight. Otherwise, it may well be that the technological progress of space vehicles will be retarded by the technological status of space powerplants. In order to direct a proper effort to the development of space powerplants, it is necessary to evaluate the various energy sources available along with the types of conversion equipment best fitted to the power spectrum of interest. The potential place of nuclear energy powerplants for space power applications and their advantages or disadvantages as compared with other types of powerplants are discussed. (auth)

17328 THE FEASIBILITY OF PROPELLING VEHICLES BY CONTAINED NUCLEAR EXPLOSIONS. Dandridge M.

Cole (Martin Co., Denver). p.726-43 of "Advances in the Astronautical Sciences. Volume 6." New York, The Macmillan Company, 1961.

The feasibility of propulsion by contained nuclear explosions was studied with emphasis on economic aspects. Cost of propellants per pound of payload was used as a figure of merit in comparing parametric designs of nuclear pulse rockets, solid reactor nuclear rockets, and chemical rockets for space missions. These studied indicate that the nuclear pulse rocket must be of very large size—several million pounds—in order to be economically attractive. This would be comparable in size to the gaseous-core fission system, as well as other proposed advanced nuclear propulsion systems. The pulse rocket has the advantage over conventional nuclear propulsion systems in that average thrust-chamber temperatures can be far higher than for solid or even liquid reactor systems. It has the advantage over some advanced systems in that magnetic containment is not required. The expenditure (loss) of nuclear materials, while economically important in an absolute sense, is found to be relatively unimportant when measured against the very large payloads considered. (auth)

17329 AN ESTIMATE OF THE NUCLEAR RADIATION AT THE LUNAR SURFACE. John A. Barton (Boeing Airplane Co., Seattle). p.794-804 of "Advances in the Astronautical Sciences. Volume 6." New York, The Macmillan Company, 1961.

In order to provide suggestions for lunar probe instrumentation, a basis for the interpretation of lunar probe data, and a preliminary guide for lunar manned exploration and lunar base design, an estimate of the lunar surface radiation was made. Consideration was given to the various sources of radiation including decay of radioactive elements in the lunar crust, activation of lunar crust by primary cosmic and solar radiation, and direct cosmic and solar radiation. Plausible assumptions were made concerning the composition of the lunar crust and the particle and energy spectra of the incident radiation. The effect of several possible magnetic field values was included. Based on the results obtained for the lunar surface radiation, the biological dosages were determined for the various sources. It is concluded that the biological dosages from lunar crust activation are small compared to the direct radiation and that the direct-radiation dose is greatly enhanced during periods of solar activity. Measurements are suggested which might test the validity of the results or to establish an upper limit for the lunar surface radiation. (auth)

17330 THE APPLICATION OF INTEGRAL THEOREMS IN MAGNETOHYDRODYNAMICS. L. Zadoff, Julian Reinheimer, and M. Bernstein (Republic Aviation Corp., Mineola, N. Y.). p.805-16 of "Advances in the Astronautical Sciences. Volume 6." New York, The Macmillan Company, 1961.

While the magnetohydrodynamic description of plasma behavior is subject to limitations, it offers a somewhat more adequate description than that given by a collection of noninteracting charged particles. It provides a simpler mathematical model than the more complete description in terms of the Boltzmann equation with interactions taken into account. Nevertheless, analytical solutions for dynamic problems are almost unobtainable for all except one-coordinate geometries. Use of integral theorems is proposed to provide answers in the affirmative or negative to a number of physical questions where numerical results are not required. An example is given to show that even where numerical answers are needed, these theorems are a guide in determining the nature of semiquantitative solutions. (auth)

WASTE DISPOSAL AND PROCESSING

17331 (CEA-2084) STOCKAGE DES BOUCHONS ET DISPOSITIFS EXPERIMENTAUX EN PROVENANCE DES REACTEURS. (Storage of Plugs and Experimental Devices from Reactors). Pierre Cerre and Emile Mestre. (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1961. 13p.

Within the general program of storage and treatment of radioactive waste produced by the various operations carried out in an atomic center, it is useful to consider separately the problem of certain waste from reactors, which, because of its size and physical nature, has to be stored with a view to being later treated and finally evacuated. A solution is proposed for this storage problem. (auth)

17332 (EURAEC-25) TREATMENT OF RADIOACTIVE WASTES. Quarterly Report No. 1 (2nd Quarter, 1960). (Brussels. Centre d'Étude de l'Énergie Nucléaire). 1960. Work Performed under United States–Euratom Joint Research and Development Program. Contract 010-60-4RDB. 35p.

The design and construction of an incinerator for burning radioactive waste are described. Methods for the fixation of radioactive concentrates were investigated, and it was concluded that asphalt is a suitable stabilizer. Results are included from a series of elution tests on radioactive slurry-asphalt mixtures in water. Methods were investigated for the removal of radioactive iodine from air. The efficiency of various gas-scrubbing procedures was evaluated. Data are included on the performance of columns packed with caustic lye of soda, special active coal in columns or filters, glass fiber filters, simple scrubbing systems consisting of a tube filled with sorbent material, and spiral glass tubes with copper-treated granular coal used as a sorbent. Investigations were made of the storage of radioactive wastes in the soil. Results are reported from measurements of the velocity of subsoil water using KI^{131}. (C.H.)

17333 (HW-69534) LABORATORY DEVELOPMENT OF A CARRIER–PRECIPITATION PROCESS FOR THE RECOVERY OF STRONTIUM FROM PUREX WASTES. L. A. Bray and H. H. Van Tuyl (General Electric Co. Hanford Atomic Products Operation, Richland). May 9, 1961. Contract AT(45-1)-1350. 45p.

Strontium recovery from Purex 1WW was investigated with simulated feeds and tracer activities. Initial experiments demonstrated recovery of over 70% of the strontium by sulfate precipitation from partially neutralized 1WW by either increasing the sulfate concentration to about 3 M or by adding carriers such as lead. Precipitation of iron was avoided by addition of one or more moles of tartrate per two moles of iron. Precipitation at elevated temperatures and addition of lead after pH adjustment were shown to be beneficial. Strontium recoveries of over 95% were achieved by precipitation at about 80°C at pH values of 0.4 to 4.0 with sulfate concentrations of 0.67 to 3 M and over 0.02 M lead carrier added. High sulfate concentrations were required at low pH, but the sulfate concentration is not critical above pH 1. Some separation of strontium from cerium was observed at pH 2 to 4, with the degree of separation being dependent on both tartrate concentration and pH. Recovery of strontium from the sulfate precipitate by leaching with nitric acid, sodium acetate, or oxalic acid was unsatisfactory because of the large volumes required. Metathesis with sodium hydroxide removed most of the lead as plumbite and converted the precipitate to an acid-soluble form, but resulted in excessive strontium losses. Metathesis with carbonate–hydroxide mixtures retained the benefits of hydroxide metathesis, and resulted in only very low strontium losses. Selective leaching of rare earths from the sulfate or carbonate precipitates using various complexing agents was generally unsuccessful. Recovery of strontium from the carbonate precipitate by washing with mixtures of nitric and oxalic acids, or by dissolution in nitric acid followed by oxalate precipitation was demonstrated. The techniques developed were successfully applied in the Purex plant in meeting Hanford's megacurie commitment of Sr^{90} for the SNAP program prototypes. (auth)

17334 (JAERI-1021) DESIGN AND CONSTRUCTION OF A RADIOACTIVE WASTE TREATMENT PLANT AT JAERI. (Japan Atomic Energy Research Inst., Tokyo). Feb. 1962. 30p. (In Japanese)

The radioactive waste treatment scheme at the Japan Atomic Energy Research Institute is described. The natures and volumes of wastes which would be expected to be discharged before starting the small scale reprocessing pilot plant operation are estimated. The treatment facility for low level liquid wastes is composed of three units: a flocculation unit using aluminium hydroxide floc generated by electrolysis, an evaporation unit using single effect evaporators in two steps, and an ion-exchange unit using two resin columns in series or in parallel (each rated capacity: $1m^3$/hr). An incineration unit composed of a fire-brick lined furnace and a wet gas-cleaning system is applied for the treatment of combustible solid wastes (rated capacity: 30 kg/8 hr-day). Radioactive concentrates, discharged from the above mentioned treatment facilities and uncombustible solid wastes, are stored finally in two concrete trenches (each capacity: 300 m^3), not disposed into ocean nor into ground. The flocculation and ion-exchange unit had a decontamination factor of more than 10^3 for low level wastes ($10^{-5} \sim 10^{-6}$ μc/ml). The evaporation unit had a D.F. of 10^6 or more for nonvolatile activities. In the incineration unit an activity level of exhausted gases from the filter may exceed the non-occupational tolerance level in air for γ-activity (10^{-9} μc/ml) when wastes having the surface doses more than 10 mr/hr are burned. Corresponding the following activity increases, it is expected that the plant should be expanded in its capacity and also be modified in its treatment systems. The completions of the JPDR (BWR-type, 47Mw), the Hot Laboratory attached to JRR-2 (CP-5 type, 10 Mw), the Radioisotope Production Facility and the small scale reprocessing pilot plant, both are concerned with JRR-3. (auth)

17335 STUDY AND EXPERIMENTS ON AN EVAPORATOR FOR RADIOACTIVE LIQUIDS. A. Facchini (Istituto di Fisica del Politecnico, Milan). Energia elettrica, 37: 1205-14(Dec. 1960). (In Italian)

Some criteria of a thermal economic character are presented for the design of an evaporator for radioactive liquids, and some experiments on the construction of an evaporator with coaxial tubes and thermocompression and with natural circulation of the evaporating liquid are described. A decontamination factor of 10^6 can be obtained, and the evaporator will yield 250 kg/hr of distillate with a power consumption of 1 kwh/26 kg distillate. The complete specific cost for the treatment of the liquid is 5.50 l/kg of distil'ate. (tr-auth)

17336 SEPARATION OF Cs^{137} AND Sr^{90} FROM OLD FISSION PRODUCTS BY ELECTROPHORESIS. II. DEPENDENCE OF MIGRATION LENGTHS FROM ELECTRIC FIELD AND MIGRATION TIME. E. Lazzarini (CESNEF, Milan). Energia nucleare (Milan), 9: 40-2(Jan. 1962). (In English)

The dependence of migration length on electric field intensity and migration time was studied for the electrophoretic separation of Cs^{137} and Sr^{90} from fission products. The separations were carried out at voltages of 600, 750, 1000, 1900, and 3000 v. The results obtained were tabulated and show that the migration length is linearly dependent on time. The separation between Sr^{2+} and Cs^{+} can be expressed as the ratio of the ion mobilities Cs/Sr which is 1.53 + 0.03. The ion migration rate in an electric field increases with the valency and decreases with the ion mass. (J.S.R.)

17337 RECOVERY OF CESIUM FROM FISSION PRODUCT SOLUTIONS BY MEANS OF ZIRCONIUM PHOSPHATE DESSICATED AT HIGH TEMPERATURE. G. Alberti and A. Conte (Università, Rome and CNEN, Rome). Energia nucleare (Milan), 9: 43-4(Jan. 1962). (In Italian)

The ion exchange of cesium on zirconium phosphate desiccated at high temperature was studied by means of the saturation curve and compared with results obtained using zirconium phosphate prepared in the usual manner. All the results show that the high-temperature desiccated zirconium phosphate had a 30 to 40% higher capacity than zirconium phosphate dried at 50°C. (J.S.R.)

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ALC
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AMS
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ARC
M
M
R
ARI
H
AR
C
C
ATC
L
ATC
A

CORPORATE AUTHOR INDEX

This index contains entries for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

Each entry under a corporate author is a shortened version of the title of the publication, followed by the NSA volume and abstract number. Report numbers are given in parentheses.

The phrase "Progress report" is abbreviated as "Prog. rpt." This change permits a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

A

AERONAUTICAL SYSTEMS DIV., WRIGHT-PATTERSON AFB, OHIO.
Compatibility of containment metals with Cs, 16: 16684 (TID-7626(Pt.I)(p.109-10))
AERONAUTICAL SYSTEMS DIV. MATERIALS CENTRAL, WRIGHT-PATTERSON AFB, OHIO.
Working fluids program, 16: 16685 (TID-7626(Pt.I)(p.111-14))
AEROSPACE CORP., EL SEGUNDO, CALIF.
Prog. rpt. on energy conversion, 16: 16800 (AD-266440)
Prog. rpt. on energy conversion, 16: 17314 (AD-266439)
AIR FORCE CAMBRIDGE RESEARCH LABS., BEDFORD, MASS.
Gas breakdown using secondary electrons, 16: 16801 (AFCRL-62-239)
AIR MATERIEL COMMAND, WRIGHT-PATTERSON AFB, OHIO.
Loading on building and equipment shapes, 16: 16574 (WT-721)
AIRESEARCH MFG. CO. DIV. OF GARRETT CORP., PHOENIX, ARIZ.
Potassium corrosion studies, 16: 16679 (TID-7626(Pt.I)(p.63-8))
AKTIEBOLAGET ATOMENERGI, STOCKHOLM.
Bibliography on (n,n) and (n,2n) reactions, 16: 17074 (VDIT-50)
Irradiation effects in pressure vessel steel, 16: 16773 (AE-65)
Modified sucksmith balances, 16: 16513 (AE-64)
ALCO PRODUCTS, INC., SCHENECTADY, N. Y.
BWR reference design for PL-3, 16: 17284 (APAE-115(Vol.I))
PWR preliminary design for PL-3, 16: 17285 (APAE-115(Vol.II))
AMSTERDAM. UNIVERSITEIT.
Elastic scattering and absorption of π^- on emulsion nuclei, 16: 16964 (NP-11592(Vol.I)(p.291-4))
ARGONNE NATIONAL LAB., ILL.
Mercury corrosion of Ti alloys, 16: 16683 (TID-7626(Pt.I)(p.107-8))
Multigroup calculations of neutron kinetics, 16: 16632 (ANL-6511)
Reactor Fuel Processing, Vol. 4, No. 3, 16: 16464
ARMED FORCES RADIOBIOLOGY RESEARCH INST., BETHESDA, MD.
Hazard report for DASA-Triga Mark F Reactor, 16: 17309 (NP-11454)
ARMY CHEMICAL CORPS NUCLEAR DEFENSE LAB., ARMY CHEMICAL CENTER, MD.
Cold weather decontamination—McCoy I, 16: 16607 (NDL-TR-24)
ATOMIC ENERGY COMMISSION, WASHINGTON, D. C.
Liquid metals corrosion meeting, 16: 16676 (TID-7626(Pt.I))
ATOMIC ENERGY OF CANADA LTD., CHALK RIVER, ONT.
Axial flux in lattice position in NRX, 16: 17232 (CRC-1058)
Calculation of thermal utilization, 16: 17238 (NEI-168)
Canada–India reactor, 16: 17306 (AECL-1443)
Defected Zy-2 clad UO_2 fuel elements, 16: 16776 (CRFD-1067)
Irradiation of UO_2 specimens, 16: 16775 (CRFD-1044)
Neutron spectra in cylinder of hot moderator, 16: 17233 (CRRP-985-D)
Prog. rpt. on physics, 16: 16811 (PR-P-52)
ATOMICS INTERNATIONAL. DIV. OF NORTH AMERICAN AVIATION, INC., CANOGA PARK, CALIF.
Carbon transfer in liquid Na systems, 16: 16682 (TID-7626(Pt.I)(p.92-100))
Energy absorption rates in OMR coolants, 16: 17236 (NAA-SR-6893)
Liquid metal corrosion research in SNAP, 16: 16681 (TID-7626(Pt.I)(p.87-91))
Prog. rpt. on refractory materials, 16: 16733 (WADD-TR-60-581(Pt.II))
AVCO CORP. AVCO-EVERETT RESEARCH LAB., EVERETT, MASS.
Current distribution for large radius-ratio mast, 16: 16803 (AFOSR-2194)
Solutions to linearized MHD flow problems, 16: 16806 (BSD-TDR-62-42)

B

BABCOCK AND WILCOX CO., LYNCHBURG, VA.
Exponential experiments on $D_2O–H_2O$ moderated lattices, 16: 17228 (BAW-1233)
Spectral shift control reactor physics, 16: 17286 (BAW-1230(Pt.II))
Theoretical analysis of SSCR. I., 16: 17227 (BAW-1230(Pt.I))
BATTELLE MEMORIAL INST., COLUMBUS, OHIO.
Methods and instruments for evaluation of refractory materials, 16: 16572 (ASD-TR-61-74)
Prog. rpt. on civilian applications, 16: 17229 (BMI-1565(Del.))
BATTELLE MEMORIAL INST. DEFENSE METALS INFORMATION CENTER, COLUMBUS, OHIO.
Defense Metals Information Center accessions, 16: 16727 (NP-11553)
BERN. UNIVERSITÄT.
Elastic scattering of protons on H_2, 16: 16939 (NP-11592(Vol.I)(p.111-15))
BIRMINGHAM. UNIV., ENGLAND.
Pion production by protons in hydrogen, 16: 16984 (NP-11592(Vol.I)(p.433-47))
BRISTOL UNIV., ENGLAND.
Hyperfragments from interactions of K mesons with emulsion, 16: 16976 (NP-11592(Vol.I)(p.363-9))
BRITISH COAL UTILISATION RESEARCH ASSN., LEATHERHEAD, SURREY, ENGLAND.
Reactivity of reactor graphite and other carbons, 16: 16338 (NPCC/MWP(G)P180)
BROOKHAVEN NATIONAL LAB., UPTON, N. Y.
Botany of strange particles, 16: 17002 (NP-11592(Vol.II)(p.141-9))
Corrosion studies in Hg and Na systems, 16: 16677 (TID-7626(Pt.I)(p.23-34))
Determination of oxygen in Na, 16: 16688 (TID-7626(Pt.I)(p.141-2))
Evidence for π-π resonance, 16: 16960 (NP-11592(Vol.I)(p.265-7))
Inelastic p-p scattering, 16: 16983 (NP-11592(Vol.I)(p.419-25))
K^0 decays, 16: 16956 (NP-11592(Vol.I)(p.241-5))
K^0 interactions, 16: 16955 (NP-11592(Vol.I)(p.235-9))
Liquid metals corrosion meeting, 16: 16676 (TID-7626(Pt.I))
Reaction $\pi^- + p \rightarrow \Lambda^0 + K^0$ at threshold, 16: 16952 (NP-11592(Vol.I)(p.203-7))
BRUSSELS. CENTRE D'ÉTUDE DE L'ÉNERGIE NUCLÉAIRE.

Prog. rpt. on solid state neutron detector, 16: 16524 (EURAEC-185)
Prog. rpt. on waste disposal, 16: 17332 (EURAEC-25)
Reprocessing of irradiated uranium, 16: 16456 (EURAEC-207)

BRUSSELS. UNIVERSITÉ.
Hyperfragments from interactions of K^- mesons with emulsion, 16: 16976 (NP-11592(Vol.I)(p.363-9))
Interactions of K^- mesons in emulsion, 16: 16975 (NP-11592(Vol.I)(p.359-61))
Prog. rpt. on transient electroanalytical methods, 16: 16305 (EURAEC-163)

BUREAU OF LABOR STATISTICS.
Employment in atomic energy, 16: 16031 (TID-14314)

BUREAU OF MINES, PITTSBURGH.
Prog. rpt. on use of liquid hydrogen in bubble chambers, 16: 16610 (TID-15422)

BUREAU OF SHIPS.
Evaluation of military radiac equipment, 16: 16530 (WT-755)

C

CALIFORNIA INST. OF TECH., PASADENA.
Astronautics information, Vol. 3, No. 3, 16: 17317 (NP-11476)
Astronautics information, Vol. 3, No. 3, 16: 17318 (NP-11493)
Bibliography of JPL publications, July 1960–June 1961, 16: 17319 (NP-11568)
Bibliography on thermionic and thermoelectric conversion, 16: 17315 (JPLAI-LS-392)
Photoproduction of ω^0 mesons from H_2, 16: 17065 (CTSL-32)
Radiation effects on solid rocket motor components, 16: 16778 (JPL-TR-32-234)

CALIFORNIA. UNIV., BERKELEY.
Selection rule $\Delta Q = \Delta S$, 16: 16953 (NP-11592(Vol.I)(p.209-15))

CALIFORNIA. UNIV., BERKELEY. INST. OF ENGINEERING RESEARCH.
Local fallout deposition patterns, 16: 16596 (CDRP-182-101)

CALIFORNIA. UNIV., BERKELEY. LAWRENCE RADIATION LAB.
K^+-nucleon total and differential cross-sections, 16: 16957 (NP-11592(Vol.I)(p.247))
Mean life of Pi meson, 16: 17006 (UCRL-10118)
Neutron background from betatron, 16: 17158 (SCR-481)

CALIFORNIA. UNIV., LIVERMORE. LAWRENCE RADIATION LAB.
Resonance neutron activation measurements, 16: 17072 (PNE-113P)

CANADA. DEPT. OF NATIONAL HEALTH AND WELFARE, OTTAWA.
Radioactive fallout study, 16: 16598 (CNHW(RP-4))

CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., COLUMBIA, S. C.
Hazards report on Parr Shoals Reactor, 16: 16599 (CVNA-90(Pt.B, Vol.I))
Hazards report on Parr Shoals Reactor, 16: 16600 (CVNA-90(Pt.B, Vol.II))
Hazards report on Parr Shoals Reactor, 16: 16601 (CVNA-90(Pt.B, Vol.III))
Hazards report on Parr Shoals Reactor, 16: 16602 (CVNA-90(Pt.B, Vol.IV))

CENTRO INFORMAZIONI STUDI ESPERIENZE, MILAN.
Prog. rpt. on steam–water spray for reactor cooling, 16: 17291 (EURAEC-222)

CHEMICAL AND RADIOLOGICAL LABS., ARMY CHEMICAL CENTER, MD.
Evaluation of chemical dosimeters, 16: 16529 (WT-753)

CHICAGO. UNIV. ENRICO FERMI INST. FOR NUCLEAR STUDIES.
Capture rate for muons in He, 16: 16943 (NP-11592(Vol.I)(p.141))
Strange particle physics, 16: 17003 (NP-11592(Vol.II)(p.151-75))

CINCINNATI. UNIV.
Lung cancer in rats from radioactive Ce, 16: 16177 (NYO-10056)

CLERMONT-FERRAND, FRANCE. UNIVERSITE.
"Incorporated target" technique with nuclear emulsions, 16: 16967 (NP-11592(Vol.I)(p.307-25))

COLLÈGE DE FRANCE, PARIS.
Quasi-real processes in high-energy physics, 16: 16950 (NP-11592(Vol.I)(p.191-5))

COLUMBIA UNIV., NEW YORK.
Lepton physics, 16: 16994 (NP-11592(Vol.II)(p.3-13))
Reaction $\pi^- + p \rightarrow \Lambda^0 + K^0$ at threshold, 16: 16952 (NP-11592(Vol.I)(p.203-7))

COLUMBIA UNIV., PALISADES, N. Y. LAMONT GEOLOGICAL OBSERVATORY.
Isotopic geochemistry, 16: 16577 (TID-14861(Vols.I and II))

COMPAGNIE GÉNÉRALE DE TÉLÉGRAPHIE SANS FIL, PARIS.
Diffusion of fission gases in UO_2, 16: 16650 (EURAEC-194(App.7))
Furnace for preparing powders of UO_2, 16: 16644 (EURAEC-194(App.1))
Moist hydrogen as sintering atmosphere, 16: 16647 (EURAEC-194(App.4))
Resistance to thermal shock, 16: 16646 (EURAEC-194(App.3))
Soldering of stainless steel tubes to Zy, 16: 16649 (EURAEC-194(App.6))
UO_2 sintering preliminary to irradiation, 16: 16648 (EURAEC-194(App.5))

COMPAGNIE INDUSTRIELLE DES COMBUSTIBLES ATOMIQUES FRITTES, CORBEVILLE, PAR ORSAY (SEINE-ET-OISE), FRANCE.
Molding of UO_2, 16: 16645 (EURAEC-194(App.2))
Prog. rpt. on UO_2 extrusion, 16: 16697 (EURAEC-62)
Prog. rpt. on UO_2 extrusion, 16: 16698 (EURAEC-195)

CORNELL AERONAUTICAL LAB., INC., BUFFALO.
Prog. rpt. on thermal expansion of ceramics, 16: 16715 (CAL-PI-1273-M-10)

CORNELL UNIV., ITHACA, N. Y.
Electric structure of nucleons, 16: 16996 (NP-11592(Vol.II)(p.21-31))

D

DIVISION OF TECHNICAL INFORMATION, AEC.
Doorway to Legal News, Vol. 6, No. 2, 16: 16035

DIVISION OF TECHNICAL INFORMATION EXTENSION, AEC.
Bibliographies on atomic energy literature, 16: 16030 (TID-3710)

DU PONT DE NEMOURS (E. I.) & CO. EXPLOSIVES DEPT., WILMINGTON, DEL.
Prog. rpt. on heavy water reactors, 16: 17290 (DP-715)

DU PONT DE NEMOURS (E. I.) & CO. SAVANNAH RIVER LAB., AIKEN, S. C.
Coolant void reactivity coefficients, 16: 17234 (DP-641)
Prog. rpt. on miniature purification. I., 16: 16335 (DP-678)

E

EDGERTON, GERMESHAUSEN AND GRIER, INC., BOSTON.
Technical photography of surface motion, 16: 16528 (VUP-2202)
Timing and firing for Project Gnome, 16: 16029 (PNE-115P)

ENGINEER RESEARCH AND DEVELOPMENT LABS., FORT BELVOIR, VA.
Water demineralization and decontamination, 16: 16603 (ERDL-1671-TR)

EUROPEAN COUNCIL FOR NUCLEAR RESEARCH, GENEVA.
Proton scattering in region 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH, GENEVA.
Annihilation in flight of positrons, 16: 16946 (NP-11592(Vol.I)(p.151-3))
Antiproton-proton total cross sections, 16: 16963 (NP-11592(Vol.I)(p.283-6))
Bending high-energy particles in nuclear emulsions, 16: 16966 (NP-11592(Vol.I)(p.301-5))
Decay rate of negative muons, 16: 16944 (NP-11592(Vol.I)(p.143-5))
Elastic and inelastic p-p scattering, 16: 16981 (NP-11592(Vol.I)(p.397-406))
Electromagnetic structure of pions and nucleons, 16: 16997 (NP-11592(Vol.II)(p.33-55))
High energy physics above 10 Gev, 16: 17000 (NP-11592(Vol.II)(p.103-24))
High energy physics above 10 Gev, 16: 17001 (NP-11592(Vol.II)(p.125-39))
Interactions of protons and π^- in H_2, 16: 16982 (NP-11592(Vol.I)(p.407-17))
Method for determining proton polarization, 16: 16965 (NP-11592(Vol.I)(p.295-9))
On nucleon-nucleon potential, 16: 16972 (NP-11592(Vol.I)(p.347-9))

On pion-pion scattering, 16: 16971 (NP-11592(Vol.I)(p.343-6))
Photon production in p-p collisions, 16: 16934 (NP-11592(Vol.I)(p.73-7))
Production of electron pairs by pions, 16: 16935 (NP-11592(Vol.I)(p.79-83))
Scattering of μ mesons on electrons, 16: 16945 (NP-11592(Vol.I)(p.147-50))
V^0 pairs produced in propane bubble chamber, 16: 16938 (NP-11592(Vol.I)(p.101-10))

F

FRANCE. COMMISSARIAT À L'ÉNERGIE ATOMIQUE, PARIS.
Electrical resistivity of sintered UO$_2$, 16: 16720 (EURAEC-213)
Prog. rpt. on UO$_2$ sintering, 16: 16642 (EURAEC-3)
Prog. rpt. on UO$_2$ sintering, 16: 16643 (EURAEC-194)
FRANCE. COMMISSARIAT À L'ÉNERGIE ATOMIQUE. CENTRE D'ÉTUDES NUCLÉAIRES, GRENOBLE.
Blood volume of rat using Cr-51, 16: 16103 (CEA-2112)
Burnout heat fluxes for two-phase water–steam in forced convection, 16: 16499 (CEA-Bib-28)
FRANCE. COMMISSARIAT À L'ÉNERGIE ATOMIQUE. CENTRE D'ÉTUDES NUCLÉAIRES, SACLAY.
Apparatus for differential thermal analysis, 16: 16522 (CEA-2094)
Conference on elementary particles, Aix-en-Provence, Sept., 1961, 16: 16925 (NP-11592(Vol.I))
Conference on elementary particles, Aix-en-Provence, Sept., 1961, 16: 16993 (NP-11592(Vol.II))
Control of concentration in gaseous diffusion plant, 16: 16626 (CEA-2010)
Delayed neutron detection in burst can detection, 16: 16523 (CEA-2101)
Design of nuclear free-precession magnetometer, 16: 16519 (CEA-1931)
Electron microscope study of BeO, 16: 16735 (AEC-tr-5028)
Fast-neutron spectroscopy methods, 16: 16520 (CEA-2002)
Fluctuations in system depending on random parameters, 16: 17231 (CEA-2115)
Formation of gases and H$_2$O$_2$ in Triton water, 16: 16332 (CEA-2088)
Hydromagnetic stability criterion for plasma, 16: 17181 (AEC-tr-5033)
Krypton purification, 16: 16455 (CEA-2111)
Mercury porosimeter for nuclear graphite, 16: 16521 (CEA-2093)
Neutral processes in π^--p interaction, 16: 16932 (NP-11592(Vol.I)(p.45-55))
Nuclear matter at low density, 16: 17063 (CEA-2086)
On π-π interaction phase shifts, 16: 16969 (NP-11592(Vol.I)(p.331-5))
π-production in p-p collisions, 16: 16933 (NP-11592(Vol.I)(p.57-67))
Pion-nucleon interactions, 16: 16989 (NP-11592(Vol.I)(p.467-83))
Pion production by π^+, 16: 16930 (NP-11592(Vol.I)(p.27-35))
Proton scattering in region 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))
Reaction of UF$_6$ with other halides, 16: 16334 (CEA-2110)
Reactivity of graphite with respect to CO$_2$ and air, 16: 16331 (CEA-1934)
Solid state processing of massive UN, 16: 16452 (CEA-2103)
Storage of plugs and devices from reactors, 16: 17331 (CEA-2084)
Study of UO$_2$F$_2$–H$_2$O–HF compounds, 16: 16333 (CEA-2106)
FRANCE. COMMISSARIAT À L'ENERGIE ATOMIQUE. CENTRE DE PRODUCTION DE PLUTONIUM DE MARCOULE, CHUSCLAN.
Safety apparatus for radioactive accidents, 16: 16597 (CEA-2113)
FRANCE. INSTITUT NATIONAL DES SCIENCES ET TECHNIQUES NUCLÉAIRES, PARIS.
Fast-neutron spectroscopy methods, 16: 16520 (CEA-2002)
Neutron noise in nuclear reactors, 16: 17230 (CEA-1855)

G

GENERAL ATOMIC DIV., GENERAL DYNAMICS CORP., SAN DIEGO, CALIF.
Geometric effects in HTGR annual resonance integral calculations, 16: 17295 (GAMD-2660)
Hazard report for DASA-Triga Mark F Reactor, 16: 17309 (NP-11454)
Plenum to reflector block seal for HTGR, 16: 17294 (GAMD-1375)
Prog. rpt. on carbide cathode studies, 16: 16807 (GA-3093)
Prog. rpt. on gas-cooled reactor, 16: 17293 (GA-2861)
Prog. rpt. on high-temperature semiconductors, 16: 16799 (AD-265462)
Safeguards for the EBOR Critical Experiment, 16: 16604 (GA-1100(Suppl.3))
Vapor transport of U from UC$_2$–C compacts, 16: 16721 (GAMD-1233)
GENERAL DYNAMICS/FORT WORTH. DIV. OF GENERAL DYNAMICS CORP., FORT WORTH, TEX.
Behavior of irradiated polyurethane elastomers, 16: 16779 (NARF-62-2T)
Effects of radiation on mix bis ether, 16: 16780 (NARF-62-3T)
GENERAL ELECTRIC CO. AIRCRAFT NUCLEAR PROPULSION DEPT., CINCINNATI.
Analysis of oxygen in alkali metal, 16: 16687 (TID-7626(Pt.I)(p.130-40))
Effect of body intersecting flow channel, 16: 16500 (DC-59-11-57)
High temperature radiation tolerant component program, 16: 16777 (DC-58-4-71)
Neutron radiative absorption cross section, 16: 17070 (NDA-2093-7)
Reactor assembly and auxiliary systems, 16: 17289 (DC-55-11-25)
GENERAL ELECTRIC CO. AIRCRAFT NUCLEAR PROPULSION DEPT., EVENDALE, OHIO.
FORTRAN Monte Carlo program. I., 16: 16633 (DC-59-12-83)
GENERAL ELECTRIC CO. AIRCRAFT NUCLEAR PROPULSION PROJECT, CINCINNATI.
Hydrogenous shield materials, 16: 17221 (DC-52-5-41)
Metal screen, folded, water moderated air cycle reactor, 16: 17288 (DC-52-4-37)
GENERAL ELECTRIC CO. FLIGHT PROPULSION LAB. DEPT., CINCINNATI.
Liquid metal investigations, 16: 16680 (TID-7626(Pt.I)(p.69-86))
GENERAL ELECTRIC CO. HANFORD ATOMIC PRODUCTS OPERATION, RICHLAND, WASH.
Axial expansion of lathe spindles, 16: 16473 (HW-71980)
Recovery of Sr from Purex wastes, 16: 17333 (HW-69534)
Release of radiostrontium from strontium carbonate, 16: 16336 (HW-69692)
Welding sintered Al powder materials, 16: 16699 (HW-72379)
GENERAL ELECTRIC CO. MATERIALS AND PROCESSES LAB., SCHENECTADY, N. Y.
Aging reactions in René 41, 16: 16718 (DF-59-SL-314)
GENERAL ELECTRIC CO. RESEARCH LAB., SCHENECTADY, N. Y.
Brittleness of refractory metals, 16: 16705 (62-GC-206)
GENERAL ELECTRIC CO. VALLECITOS ATOMIC LAB., SAN JOSE, CALIF.
Prog. rpt. on UO$_2$ program, 16: 17296 (GEAP-3771-2)
GENERAL ELECTRIC CO., LTD., WEMBLEY, ENGLAND.
Radiation induced reaction between CO$_2$ and graphite, 16: 16408 (NPCC/MWP(G)/P161)
Reaction between C and CO$_2$ under irradiation, 16: 16407 (NPCC/MWP(G)/P157)
GENERAL MOTORS CORP. RESEARCH LABS., WARREN, MICH.
Form factors of neutron and structure of nucleons, 16: 16941 (NP-11592(Vol.I)(p.121-37))
GIANNINI CONTROLS CORP., PASADENA, CALIF.
Solid state solar generator, 16: 16518 (ASD-TR-61-564)
GOODYEAR ATOMIC CORP., PORTSMOUTH, OHIO.
Health and safety report for 1961, 16: 16605 (GAT-R-281)
GT. BRIT. NATIONAL INST. FOR RESEARCH IN NUCLEAR SCIENCE, HARWELL, BERKS, ENGLAND.
Inelastic p-p scattering, 16: 16983 (NP-11592(Vol.I)(p.419-25))
GRENOBLE, FRANCE. UNIVERSITÉ.
Design of nuclear free-precession magnetometer, 16: 16519 (CEA-1931)

H

HARVARD UNIV., CAMBRIDGE, MASS.
Broad-line NMR spectrometer, 16: 16525 (NP-11497)
HOLMES AND NARVER, INC., LOS ANGELES.
Gnome pre-shot and post-shot structure survey, 16: 16608 (PNE-127P)
Hazard report for DASA-Triga Mark F Reactor, 16: 17309 (NP-11454)

I

ILLINOIS INST. OF TECH., CHICAGO. ARMOUR RESEARCH FOUNDATION.
Loading of horizontal cylindrical shapes, 16: 16481 (WT-722)
Prog. rpt. on vanadium alloys, 16: 16712 (ARF-2231-3)
Prog. rpt. on Zr alloys, 16: 16674 (ARF-2198-24)
Thermochemical data on compounds for energy conversion, 16: 16805 (ARF-3182-5)
ILLINOIS. UNIV., URBANA.
Elementary excitations in liquid He, 16: 17061 (AROD-431:45)
Influence of electron interactions on metals, 16: 16713 (AROD-431:44)
Polarization of neutrons from photodisintegration of D, 16: 16924 (NP-11509)
IMPERIAL COLL. OF SCIENCE AND TECH., LONDON.
Low-energy pion physics, 16: 16999 (NP-11592(Vol.II)(p.87-102))
Pion production by protons in hydrogen, 16: 16984 (NP-11592(Vol.I)(p.433-47))
Strange isobars, 16: 17005 (NP-11592(Vol.II)(p.191-204))
INDIA. ATOMIC ENERGY ESTABLISHMENT, TROMBAY.
Handling hazards of natural Th, 16: 16593 (AEET/HP/SM-5)
Radiation hazards in uranium mines, 16: 16592 (AEET/HP/SM-4)
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA.
Conference on effects of radiation on nervous system, 16: 16253
Conference on radioisotopes. I., 16: 16037
Symposium on radiation in entomology, 16: 16108
Symposium on tritium in science, 16: 16076
Symposium on whole-body counting, 16: 16133
Vinca dosimetry experiment, 16: 16618
INTERNATIONAL BUSINESS MACHINES CORP., SAN JOSE, CALIF.
Whirl in air-lubricated journal bearings, 16: 16475 (NP-11494)
IOWA. STATE UNIV., IOWA CITY.
Cluster model and nuclear transmutation, 16: 17073 (SUI-61-6)
ISRAEL. ATOMIC ENERGY COMMISSION, REHOVOTH.
Gauges, groups, and theory of strong interactions, 16: 17066 (IA-698)
Hyperon-pion resonances, 16: 16980 (NP-11592(Vol.I)(p.389-94))
ISRAEL INST. OF TECH., HAIFA.
Array for investigation of air showers, 16: 16514 (AFCRL-1092)
ITALY. COMITATO NAZIONALE PER L'ENERGIA NUCLEARE, ISPRA.
Canning materials for gas-cooled reactor, 16: 17287 (CNI-102)
ITALY. COMITATO NAZIONALE PER L'ENERGIA NUCLEARE, ROME.
Determination of B, Al, Fe, Mn and Cr in U, 16: 16304 (CNEN-96)
ITALY. COMITATO NAZIONALE PER L'ENERGIA NUCLEARE. LABORATORI NAZIONALI, FRASCATI.
Photoproduction of π^0 mesons in H_2, 16: 16926 (NP-11592(Vol.I)(p.9-15))
Polarization of protons from $\gamma + p \to \pi^0 + p$, 16: 16927 (NP-11592(Vol.I)(p.17-20))
Possibilities with colliding beams of electrons and positrons, 16: 16992 (NP-11592(Vol.I)(p.487-501))
ITALY. ISTITUTO NAZIONALE DI FISICA NUCLEARE, MILAN.
Low-multiplicity jets produced by high-energy pions, 16: 16986 (NP-11592(Vol.I)(p.453-7))
Momentum spectrum of slow protons, 16: 16985 (NP-11592(Vol.I)(p.449-52))
ITALY. ISTITUTO NAZIONALE DI FISICA NUCLEARE, ROME.
Photoproduction of π^+ mesons in H_2, 16: 16928 (NP-11592(Vol.I)(p.21-4))

J

JAPAN ATOMIC ENERGY RESEARCH INST., TOKYO.
Construction of JRR-3, 16: 17308 (JAERI-5008)
JRR-2 cooling tower test, 16: 17307 (JAERI-1022)
Radioactive waste treatment plant, 16: 17334 (JAERI-1021)
JOHNS HOPKINS UNIV., BALTIMORE.
Rotational states of polar molecules in rare gas crystals, 16: 16330 (AD-264708)
Three-pion resonances in π^+-D reactions, 16: 16962 (NP-11592(Vol.I)(p.277-82))
JOINT INST. FOR NUCLEAR RESEARCH, DUBNA, U.S.S.R.
Determination of coordinates of minima of functionals, 16: 16634 (JINR-D-810)
Effective radius of particle interaction, 16: 16923 (JINR-E-859)
Highest partial waves in low energy approximation, 16: 17067 (JINR-D-857)
Kemmer scalar symmetrical model, 16: 17068 (JINR-D-860)
Scattering of pions and nucleons at high energies, 16: 17069 (JINR-D-922)

K

KARLSRUHE, GERMANY. TECHNISCHE HOCHSCHULE.
π-N forward scattering, 16: 16991 (NP-11592(Vol.I)(p.485-6))
KERNFORSCHUNGSANLAGE, JÜLICH, GERMANY.
Bibliography on direct energy conversion, 16: 16808 (NP-11472)
High-temperature plasmas by magnetic compression, 16: 17177 (JUL-36-PP)
Structure of electrodeless ring discharge, 16: 17176 (JUL-33-PP)

L

LOCKHEED AIRCRAFT CORP., SUNNYVALE, CALIF.
Shielding bibliography, 16: 17222 (NP-11466)
LONDON. UNIV. UNIVERSITY COLL.
Hyperfragments from interactions of K^- mesons with emulsion, 16: 16976 (NP-11592(Vol.I)(p.363-9))
Low energy p-n scattering and p-p interactions, 16: 16973 (NP-11592(Vol.I)(p.351-4))
Parameters of low-energy pion physics, 16: 16987 (NP-11592(Vol.I)(p.459))
Partial wave amplitudes for ingoing and outgoing particles, 16: 16970 (NP-11592(Vol.I)(p.337-42))
Pion-nucleon phase shifts, 16: 16988 (NP-11592(Vol.I)(p.461))
Proton-proton elastic scattering, 16: 16936 (NP-11592(Vol.I)(p.85-91))
LOS ALAMOS SCIENTIFIC LAB., N. MEX.
Prog. rpt on Lampre, 16: 17297 (LAMS-2681)
Vaporization behavior and properties of HfB_2, 16: 16722 (LA-2611)
LYON. UNIVERSITÉ.
Reaction of UF_6 with other halides, 16: 16334 (CEA-2110)

M

MALLINCKRODT CHEMICAL WORKS. URANIUM DIV., WELDON SPRING, MO.
Sample bottles and bottle-sealing methods, 16: 16474 (MCW-1455)
MARTIN CO., BALTIMORE.
Structural response of Be sheet, 16: 16714 (ASD-TR-61-87)
MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
Diffusion of plasma across magnetic field, 16: 17175 (AFCRL-1028)
Heat transfer in nucleate pool boiling, 16: 16503 (NP-11491)
Prog. rpt. on materials, processes and devices related to energy conversion, 16: 16710 (AD-267028)
Prog. rpt. on thermal resistance of metal contacts, 16: 16476 (NYO-9457)
METALLGESELLSCHAFT A. G., FRANKFURT AM MAIN.
Constitution of Zr–Nb alloys, 16: 16719 (EURAEC-137)
MICHIGAN. INST. FOR FISHERIES RESEARCH, ANN ARBOR.
Prog. rpt. on productivity in stream ecosystems, 16: 16172 (TID-15385)
MICHIGAN STATE UNIV., EAST LANSING.
Prog. rpt. on productivity in stream ecosystems, 16: 16172 (TID-15385)
MICHIGAN. UNIV., ANN ARBOR.
Prog. rpt. on productivity in stream ecosystems, 16: 16172 (TID-15385)
MILAN. UNIVERSITÀ.
Low-multiplicity jets produced by high-energy pions, 16: 16986 (NP-11592(Vol.I)(p.453-7))
Momentum spectrum of slow protons, 16: 16985 (NP-11592(Vol.I)(p.449-52))
MINE SAFETY APPLIANCES RESEARCH CORP., CALLERY, PENNA.
Determination of C in Na, 16: 16690 (TID-7626(Pt.I)(p.146-9))
MINNESOTA. UNIV., MINNEAPOLIS.
Prog. rpt. on two-phase compressible flow, 16: 16504 (TID-15429)

N

NANCY. UNIVERSITÉ.
Reactivity of graphite with respect to CO_2 and air, 16: 16331 (CEA-1934)
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, WASHINGTON, D. C.
Liquid metals corrosion meeting, 16: 16676 (TID-7626(Pt.I))
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.
Instrumentation of ionosphere measurements satellite, 16: 17316 (NASA-TN-D-414)
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LEWIS RESEARCH CENTER, CLEVELAND.
Monte Carlo study of resonance escape, 16: 17237 (NASA-TN-D-1184)
NATIONAL BUREAU OF STANDARDS, WASHINGTON, D. C.
Process for applying ceramic and cermet coatings, 16: 16641 (ARL-59)
Tables of spectral-line intensities, 16: 16337 (NBS-MON-32(Pt.II))
NATIONAL RESEARCH COUNCIL. COMMITTEE ON NUCLEAR SCIENCE.
Radiochemistry of U, 16: 16405 (NAS-NS-3050)
NATIONAL RESEARCH COUNCIL. NUCLEAR DATA GROUP.
Nuclear data tables. IV, 16: 17154
NAVAL RADIOLOGICAL DEFENSE LAB., SAN FRANCISCO.
Decontamination of ships surfaces. II., 16: 16611 (USNRDL-TR-549)
Skin transplants and blood cells of donor bone marrow, 16: 16178 (USNRDL-TR-553)
NEW YORK EYE AND EAR INFIRMARY, NEW YORK.
Physiological changes of eye to x radiation, 16: 16175 (ASD-TR-61-415)
NEW YORK OPERATIONS OFFICE. HEALTH AND SAFETY LAB., AEC.
Fallout from 1961 USSR test series, 16: 16606 (HASL-121)
NORTH CAROLINA STATE COLL., RALEIGH.
Two connected nuclear transformations, 16: 17062 (AROD-2543:6)
NORTHWESTERN UNIV., EVANSTON, ILL.
Three-pion resonances in π^+-D reactions, 16: 16962 (NP-11592(Vol.I)(p.277-82))
NUCLEAR DEVELOPMENT CORP. OF AMERICA, WHITE PLAINS, N. Y.
Neutron radiative absorption cross section, 16: 17070 (NDA-2093-7)
NUCLEAR METALS, INC., CONCORD, MASS.
Ductility of Zy-clad fuel elements, 16: 16723 (NMI-7211)
Prog. rpt. on Be research, 16: 16725 (NMI-9517)
Prog. rpt. on refractory phase diagrams, 16: 16724 (NMI-9238)

O

OAK RIDGE NATIONAL LAB., TENN.
Alkali metal analytical program at ORNL, 16: 16686 (TID-7626(Pt.I)(p.128-9))
Brazing alloys for stainless steel fuel elements, 16: 16675 (ORNL-2834)
Cost of processing stainless steel-jacketed UO_2 fuel, 16: 16457 (ORNL-3227)
Effect of reduced U-235 price on fuel costs, 16: 17298 (ORNL-TM-191)
MURGATROYD—program for analysis of MSRE, 16: 17239 (ORNL-TM-203)
Shield of Illinois Univ. Triga Mark II reactor, 16: 17310 (ORNL-TM-178)
Strain-fatigue properties of Inconel, 16: 16728 (ORNL-3250(Pt.I))
Strain-fatigue properties of Inconel, 16: 16729 (ORNL-3250(Pt.II))
OFFICE OF NAVAL RESEARCH, WASHINGTON, D. C.
Form factors of neutron and structure of nucleons, 16: 16941 (NP-11592(Vol.I)(p.121-37))
OXFORD UNIV.
Antiproton annihilation into two charged pions, 16: 16961 (NP-11592(Vol.I)(p.269-75))
Pion production by protons in hydrogen, 16: 16984 (NP-11592(Vol.I)(p.433-47))

P

PADUA. UNIVERSITÀ
Antiproton annihilation into two charged pions, 16: 16961 (NP-11592(Vol.I)(p.269-75))
Electromagnetic structure of pions and nucleons, 16: 16997 (NP-11592(Vol.II)(p.33-55))
$\bar{K}$N and KN energy dependent s-wave scattering lengths, 16: 16974 (NP-11592(Vol.I)(p.355-8))
Pion production by π^+ on protons, 16: 16929 (NP-11592(Vol.I)(p.25-6))
Proton scattering in region 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))
Selection rule $\Delta Q = \Delta S$, 16: 16953 (NP-11592(Vol.I)(p.209-15))
PARIS. ECOLE POLYTECHNIQUE.
β decay of Λ^0 and Σ hyperons, 16: 16951 (NP-11592(Vol.I)(p.197-200))
K_2^0 decay in a Wilson chamber, 16: 16954 (NP-11592(Vol.I)(p.227-34))
Low-multiplicity jets produced by high-energy pions, 16: 16986 (NP-11592(Vol.I)(p.453-7))
PARIS. UNIVERSITÉ.
Electron-proton scattering, 16: 16942 (NP-11592(Vol.I)(p.139-40))
Elementary excitations in liquid He, 16: 17061 (AROD-431:45)
Fast-neutron spectroscopy methods, 16: 16520 (CEA-2002)
Model for elementary particle systems, 16: 16949 (NP-11592(Vol.I)(p.171-81))
Nuclear matter at low density, 16: 17063 (CEA-2086)
Solid state processing of massive UN, 16: 16452 (CEA-2103)
PHILLIPS PETROLEUM CO. ATOMIC ENERGY DIV., IDAHO FALLS, IDAHO.
Prog. rpt. on Spert project, 16: 17235 (IDO-16750)
PHYSICS, ENGINEERING, CHEMISTRY CORP., BOULDER, COLO.
Biomedical effects of EM radiation. II., 16: 16174 (ASD-TR-61-195)
PISA, ITALY. UNIVERSITÀ.
Strange particle production in H_2, 16: 16937 (NP-11592(Vol.I)(p.93-100))
POLISH ACADEMY OF SCIENCES. INST. OF NUCLEAR PHYSICS, KRAKOW.
Theory of (y,d) reactions, 16: 17071 (NP-11564)
POLISH ACADEMY OF SCIENCES. INST. OF NUCLEAR RESEARCH, WARSAW.
Analysis of radioactive solutions, 16: 16306 (PAN-250/XIII)
Cubic-hexagonal transformation in Co, 16: 16731 (PAN-246/I-B)
Isolation and purification of glycoprotein fraction, 16: 16104 (PAN-252/X)
PRATT AND WHITNEY AIRCRAFT DIV., UNITED AIRCRAFT CORP., HARTFORD, CONN.
Acoustical behavior of heat exchangers, 16: 16505 (TIM-280)
Analysis of perforated beams in bending, 16: 16477 (TIM-390)
Beryllium thermal cycle tests, 16: 16732 (TIM-312)
Fireball hydrodynamics, 16: 17292 (FXM-428)
Hazards report on high flux test reactor for CANEL, 16: 16609 (PWAC-153)
Sodium–K alloy to Hg boiler, 16: 16502 (FXM-208)
PRATT AND WHITNEY AIRCRAFT DIV., UNITED AIRCRAFT CORP., MIDDLETOWN, CONN.
Analysis of cylindrical pressure vessel, 16: 16478 (TIM-408)
PRATT AND WHITNEY AIRCRAFT DIV., UNITED AIRCRAFT CORP. CONNECTICUT AIRCRAFT NUCLEAR ENGINE LAB., MIDDLETOWN.
Alloy of Nb with 1% Zr, 16: 16716 (CNLM-2166)
Hastelloy convection NaK corrosion loop tests, 16: 16691 (TIM-435)
Pesco pump in 2000 gpm water loop, 16: 16479 (TIM-438)
Removal cross sections of C and O_2, 16: 17064 (CNLM-3244)
Stainless steel–sodium corrosion loop tests, 16: 16692 (TIN-490)
PRINCETON–PENNSYLVANIA ACCELERATOR, PRINCETON, N. J.
Magnet power servo system for proton synchrotron, 16: 17157 (PPAD-442D)
PRINCETON UNIV., N. J.
Neutron measurement methods, 16: 17058 (NYO-7877(Rev.I))
PUBLIC HEALTH SERVICE, WASHINGTON, D. C.
Radiological Health Data, Vol. 3, No. 1, 1962, 16: 16619 (ACCESS-125)
PURDUE UNIV., LAFAYETTE, IND.
Prog. rpt. on oxidation of Cr, 16: 16340 (TID-15370)

R

RADIO CORP. OF AMERICA. RCA LABS., PRINCETON, N. J.
Prog. rpt. on thermoelectric materials, 16: 16708 (AD-266128)
REPUBLIC AVIATION CORP., FARMINGDALE, N. Y.
Electromagnetic pinch effect for propulsion, 16: 17320 (PPL-116)
Prog. rpt. on thermionic power generator, 16: 16810 (PPL-TR-61-22)

REPUBLIC STEEL CORP. TITANIUM RESEARCH LAB., CANTON, OHIO.
Prog. rpt. on producibility of Ti–Al–Zr alloys, 16: 16706 (AD-264434)

RIAS. DIV. OF MARTIN CO., BALTIMORE.
Ionization potentials of free radicals and molecules, 16: 16406 (NP-11495)
On pion-pion scattering, 16: 16971 (NP-11592(Vol.I)(p.343-6))

RICE UNIV., HOUSTON, TEX.
Neutron background from betatron, 16: 17158 (SCR-481)

ROCKETDYNE DIV., NORTH AMERICAN AVIATION, INC., CANOGA PARK, CALIF.
Alkali metal corrosion studies at Rocketdyne, 16: 16678 (TID-7626 (Pt.I)(p.42-62))

ROE (A. V.) CANADA LTD. ORENDA ENGINES DIV., MALTON, ONT.
Separation of isotopes by gas centrifuge. Publications survey, 16: 16627 (NUCLEAR-52)

ROME AIR DEVELOPMENT CENTER, GRIFFIS AFB, N. Y.
Propagation properties of nonuniform ionized media, 16: 17179 (RADC-TN-61-99)

ROME. UNIVERSITÀ.
Photoproduction of π^+ mesons in H_2, 16: 16928 (NP-11592(Vol.I)(p.21-4))

S

SAINT LOUIS UNIV.
Effect of finite probability of detection field on enhancement of Raser, 16: 16517 (AFOSR-1794(p.15-44))
Eigenvalues of spin Hamiltonian, 16: 16516 (AFOSR-1794(p.1-14))
Theoretical study of solid state Raser, 16: 16515 (AFOSR-1794)

SANDIA CORP., ALBUQUERQUE, N. MEX.
Aluminum oxide humidity element, 16: 16526 (SC-4667(RR))
Certification of precision resistance decades, 16: 16527 (SCR-414)
Magnetogasdynamic aspects, 16: 16812 (SCR-439)
Monitoring vibrations from Gnome, 16: 16576 (PNE-129F)
Neutron background from betatron, 16: 17158 (SCR-481)
Neutron measurements in void tank of Triga Mark F reactor, 16: 17311 (SCR-480)

SAVANNAH RIVER OPERATIONS OFFICE, AEC.
Prog. rpt. on heavy water reactors, 16: 17299 (SRO-66)

SHAWINIGAN ENGINEERING CO. LTD., MONTREAL.
Canada–India reactor, 16: 17306 (AECL-1443)

SIGNAL CORPS ENGINEERING LABS., FORT MONMOUTH, N. J.
Evaluation of military radiac equipment, 16: 16530 (WT-755)

SOCIÉTÉ NATIONALE D'ÉTUDE ET DE CONSTRUCTION DE MOTEURS D'AVIATION, SURESNES, FRANCE.
Synthesis of thermal tests, 16: 16501 (EURAEC-147)

SOUTHWEST RESEARCH INST., SAN ANTONIO.
Handbook on elastomeric materials, 16: 16302 (ASD-TR-61-234)

STANFORD RESEARCH INST., MENLO PARK, CALIF.
Pressure measurements on structures, 16: 16482 (WT-740)

STANFORD UNIV., CALIF.
Form factors of neutron and structure of nucleons, 16: 16941 (NP-11592 (Vol.I)(p.121-37))
High energy physics above 10 Gev, 16: 17001 (NP-11592(Vol.II)(p.125-39))
Microwave properties of plasmas, 16: 17178 (ML-793)
Properties of finite chains of exchange-coupled atoms, 16: 16802 (AFOSR-1934)

STRASBOURG. UNIVERSITE.
Emission of Li-8 and B-8 fragments in proton-emulsion interactions, 16: 16940 (NP-11592(Vol.I)(p.117-20))

SUNDSTRAND AVIATION-DENVER, PACOIMA, CALIF.
Nitrosyl chloride solar fuel cell system, 16: 16480 (WADD-TR-60-821 (Pt.II))

SYRACUSE UNIV., N. Y.
Lattice vibrations of zincblende structure crystals, 16: 16804 (AFOSR-2300)
Prog. rpt. on radiation-induced gas reactions, 16: 16409 (TID-15424)
Prog. rpt. on stability of spherical shells, 16: 16472 (AROD-2465:1)

T

THERMO ELECTRON ENGINEERING CORP., WALTHAM, MASS.
Prog. rpt. on thermionic emitter materials, 16: 16709 (AD-267010)

TORONTO. UNIV.
Pressure stages for high-pressure/high-vacuum systems, 16: 16813 (UTIA-78)

TRIESTE. UNIVERSITÀ.
Strange particle production in H_2, 16: 16937 (NP-11592(Vol.I)(p.93-100))

U

UNION CARBIDE CORP. PARMA RESEARCH CENTER, OHIO.
Prog. rpt. on high temperature materials, 16: 16726 (NP-11311)

UNION CARBIDE CORP. RESEARCH INST., TARRYTOWN, N. Y.
Prog. rpt. on high temperature materials, 16: 16726 (NP-11311)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. AUTHORITY HEALTH AND SAFETY BRANCH, RISLEY, LANCS, ENGLAND.
Accident probability due to reactor protective system failure, 16: 16595 (AHSB(S)-R-35)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. PRODUCTION GROUP, SPRINGFIELDS, LANCS, ENGLAND.
Determination of Al in U metal, 16: 16307 (PG-Report-293)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. PRODUCTION GROUP. CHEMICAL SERVICES DEPT., WINDSCALE, SELLAFIELD, ENGLAND.
Determination of B in uranyl nitrate solutions, 16: 16308 (PG-Report-296)
Determination of Ru-103 and Ru-106, 16: 16309 (PG-Report-308)
Neutron emission from Pu billets, 16: 16809 (PG-Report-314)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. REACTOR GROUP, RISLEY, LANCS, ENGLAND.
Reactivity change calculations, 16: 17240 (TRG-Report-130)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. REACTOR GROUP. ATOMIC ENERGY ESTABLISHMENT, WINFRITH, DORSET, ENGLAND.
Assessment of iodine-in-milk levels following reactor accident, 16: 16594 (AEEW-R-138)
Burnout analysis. I., 16: 17226 (AEEW-R-117)
Flooding velocities for air and water in vertical tubes, 16: 16498 (AEEW-R-123)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. RESEARCH GROUP. ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL, BERKS, ENGLAND.
Errors in A/G proton linear accelerator, 16: 17156 (AERE-T/M-126)
FORTRAN for autocode programmers—AUTOTRAN, 16: 16631 (AERE-R-3980)
Hardening caused by gas bubbles, 16: 16711 (AERE-M-1000)
Radiation induced reaction between CO_2 and graphite, 16: 16408 (NPCC/MWP(G)/P161)
Reaction between C and CO_2 under irradiation, 16: 16407 (NPCC/MWP(G)/P157)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. RESEARCH GROUP. WANTAGE RADIATION LAB., HARWELL, BERKS, ENGLAND.
Effect of radiation on soils, 16: 16176 (NP-11578)

UNITED NUCLEAR CORP. CHEMICALS DIV., HEMATITE, MO.
Prog. rpt. on UO_2 powders, 16: 16730 (ORO-543)

UNITED NUCLEAR CORP. DEVELOPMENT DIV., WHITE PLAINS, N. Y.
Liquid metal activities at United Nuclear, 16: 16689 (TID-7626 (Pt.I)(p.143-5))
Prog. rpt. on heavy water reactors, 16: 17241 (UNC-5005)

UNITED STATES–EURATOM JOINT RESEARCH AND DEVELOPMENT PROGRAM.
Constitution of Zr–Nb alloys, 16: 16719 (EURAEC-137)
Electrical resistivity of sintered UO_2, 16: 16720 (EURAEC-213)
Prog. rpt. on solid state neutron detector, 16: 16524 (EURAEC-185)
Prog. rpt. on steam–water spray for reactor cooling, 16: 17291 (EURAEC-222)
Prog. rpt. on transient electroanalytical methods, 16: 16305

(EURAEC-163)

Prog. rpt. on UO$_2$ extrusion, 16: 16697 (EURAEC-62)

Prog. rpt. on UO$_2$ extrusion, 16: 16698 (EURAEC-195)

Prog. rpt on UO$_2$ program, 16: 17296 (GEAP-3771-2)

Prog. rpt. on UO$_2$ sintering, 16: 16642 (EURAEC-3)

Prog. rpt. on UO$_2$ sintering, 16: 16643 (EURAEC-194)

Prog. rpt. on waste disposal, 16: 17332 (EURAEC-25)

Prog. rpt. on Zr alloys, 16: 16674 (ARF-2198-24)

Reprocessing of irradiated uranium, 16: 16456 (EURAEC-207)

Synthesis of thermal tests, 16: 16501 (EURAEC-147)

UNITED STATES RUBBER CO., WAYNE, N. J.

Prog. rpt. on radiation-resistant materials, 16: 16707 (AD-265319)

UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES.

Rarefaction of plasmas, 16: 17180 (USCEC-83-212)

UPPSALA UNIV.

Antiproton interaction cross sections, 16: 16922 (AD-261903)

V

VIENNA. UNIVERSITÄT.

Elastic scattering of protons on H$_2$, 16: 16939 (NP-11592(Vol.I)(p.111-15))

Scattering and reaction amplitudes in unphysical Riemann sheets, 16: 16968 (NP-11592(Vol.I)(p.327-30))

W

WALTER REED ARMY MEDICAL CENTER. INST. OF RESEARCH, WASHINGTON, D. C.

Decontamination of food and water in nuclear war, 16: 16591 (AD-264822)

WARSAW. TECHNICAL UNIV.

Neutron noise in nuclear reactors, 16: 17230 (CEA-1855)

WATERTOWN ARSENAL, MASS.

Radiography of uranium, 16: 16573 (WAL-TR-142.1/2)

WATSON SCIENTIFIC COMPUTING LAB., NEW YORK.

Lepton physics, 16: 16994 (NP-11592(Vol.II)(p.3-13))

WEIZMANN INST. OF SCIENCE, REHOVOTH, ISRAEL.

Hyperon-pion resonances, 16: 16980 (NP-11592(Vol.I)(p.389-94))

WESTINGHOUSE ELECTRIC CORP. ATOMIC POWER DEPT., PITTSBURGH.

Mixed valence thermoelectric materials, 16: 16734 (WCAP-1655)

WESTINGHOUSE ELECTRIC CORP. ATOMIC POWER DIV., PITTSBURGH.

Prog. rpt. on Parr Shoals Reactor, 16: 17300 (WCAP-4123)

WILLIAMSON DEVELOPMENT CO., INC., WEST CONCORD, MASS.

Gas breakdown using secondary electrons, 16: 16801 (AFCRL-62-239)

WISCONSIN. UNIV., MADISON.

Dynamical similarity and intrinsic relations in MHD, 16: 17174 (AD-266636)

On π-π interactions, 16: 16958 (NP-11592(Vol.I)(p.249-56))

Prog. rpt. on applications of radioisotopes to chemical problems, 16: 16339 (TID-15369)

Selection rule $\Delta Q = \Delta S$, 16: 16953 (NP-11592(Vol.I)(p.209-15))

WRIGHT AIR DEVELOPMENT CENTER. AERONAUTICAL RESEARCH LAB., WRIGHT-PATTERSON AFB, OHIO.

Radiation induced overaging of Al alloy, 16: 16774 (ARL-132)

WRIGHT AIR DEVELOPMENT DIV. MATERIALS CENTRAL, WRIGHT-PATTERSON AFB, OHIO.

Electron gun-molecular beam instrument for free radical studies, 16: 16781 (WADD-TN-60-251)

Para-ortho shift in H$_2$–N$_2$ heat exchange, 16: 16506 (WADD-TN-60-238)

Y

YALE UNIV., NEW HAVEN.

Botany of strange particles, 16: 17002 (NP-11592(Vol.II)(p.141-9))

PERSONAL AUTHOR INDEX

Each entry after an author's name is a shortened version of the title of the report or article, followed by the *NSA* volume and abstract number. Report numbers are given in parentheses.

The phrase "Progress report" is abbreviated as "Prog. rpt." This change permits a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

Ä becomes ae
Ö oe
Ø oe
Ü ue (except in transliterated Chinese names)

A

ABASKULIEVA, L. I., Healing of infected wounds from radiation, 16: 16211
ABASOV, I. T., Changes in cardiovascular system associated with Rn therapy, 16: 16208
ABDULLIN, G. Z., Radiosensitivity of brain, 16: 16281
ABDUS SATTAR, A. B. M., Irradiation of unsaturated sultones, 16: 16437
ABE, Kusio, Wear studies in shearing process, 16: 16067
ADAIR, Attwell M., Radiation induced overaging of Al alloy, 16: 16774 (ARL-132)
ADAIR, James Ray, Improvements in brazing torches, 16: 16492
ADAIR, R. K., Botany of strange particles, 16: 17002 (NP-11592(Vol.II)(p.141-9))
ADAMS, J. B., Cost of processing stainless steel-jacketed UO_2 fuel, 16: 16457 (ORNL-3227)
ADDA, Yves, Segregation of impurities in Be, 16: 16740
ADDISON, C. C., Basic beryllium nitrate, 16: 16380
ADELSTEIN, S. J., Effects of radiation on enzymatic activity, 16: 16219
ADRIAN, Frank J., Structure of the formyl radical, 16: 16359
AESCHLIMAN, Daniel P., Equation for perfect gas plasma, 16: 17186
AFANASIEV, B. G., Radiometer for beta-active preparations, 16: 16539
AITKEN, J. H., Electronic pulse multiplier, 16: 16548
AKHIEZER, A. I., Electron relaxation and electric conductivity of a plasma, 16: 17209
AKHIEZER, I. A., Plasma fluctuations with unstable distribution function, 16: 17210
AKSENOVA, A. S., Infections in monkeys with radiation sickness, 16: 16295
ALADZHALOVA, N. A., Changes in central nervous system during radiation, 16: 16181 (JPRS-13154(p.8-15))
ALBERS, K., Luminescence behavior of CdS crystals, 16: 16863
ALBERT, Philippe, Analysis of Zr after neutron irradiation, 16: 16784
ALBERT, Roy E., Clearance of inhaled particles, 16: 16149
ALBERTI, G., Recovery of Cs from fission product solutions, 16: 17337
ALCOCK, Norman Zinken, Density measuring apparatus, 16: 16565
ALEKSEEV, Yu. P., Radiometer for beta-active preparations, 16: 16539
ALEKSEEVA, O. G., Seasonal influences on antibiotic sensitivity, 16: 16210
ALEKSIN, V. F., Electron relaxation and electric conductivity of a plasma, 16: 17209
ALEONARD, R., Rare-earth ruthenates, 16: 16837
ALEXANDER, Peter, Automatic recording of nuclear data, 16: 16636
ALFIMOV, N. N., Radiometer for beta-active preparations, 16: 16539
ALIKHANOV, A. I., Decay $\mu \to e + \gamma$, 16: 17056
ALLARD, G., Furnace for preparing powders of UO_2, 16: 16644 (EURAEC-194(App.1))
ALLEN, J. W., Gallium phosphide diodes, 16: 16551
ALLEN, N., Presynaptic failure after x irradiation, 16: 16258
ALLEN, Ralph G., Jr., Cosmic radiation—lab. observations, 16: 16193
ALLISON, G. M., Defected Zy-2 clad UO_2 fuel elements, 16: 16776 (CRFD-1067)
ALTENBURG, Edgar, Mutagenic effects of uv radiation in Drosophila, 16: 16201
ALTENBURG, Edgar, Mutation rate and uv dose in Drosophila, 16: 16204
ALTSHULER, Bernard, Clearance of inhaled particles, 16: 16149
AMADESI, P., Calibration of film badges, 16: 16615
AMALDI, U., Antiproton-proton total cross sections, 16: 16963 (NP-11592(Vol.I)(p.283-6))
AMAR, V., S-wave amplitude for the K-π system, 16: 17024
AMATI, D., On nucleon-nucleon potential, 16: 16972(NP-11592(Vol.I)(p.347-9))
AMBROSINO, Georges, Reaction $Si^{28}(n,\alpha)Mg^{25}$ at 14.6 Mev, 16: 17076
AMELINCKX, S., Preparation of UO_2 single crystals, 16: 16652
AMES, Lloyd L., Jr., Method of removing Sr ions, 16: 16467
AMMON, Konrad, Ionizing radiation after previous hypoxia, 16: 16234
ANBAR, M., Cationic fluorocomplexes in rats, 16: 16167
ANDERKO, K., Constitution of Zr–Nb alloys, 16: 16719 (EURAEC-137)
ANDERSON, E. C., Human counters using scintillators, 16: 16136
ANDERSON, H. L., Capture rate for muons in He, 16: 16943 (NP-11592(Vol.I)(p.141))
ANDERSON, R. G., Effect of neutron irradiation in U, 16: 16796
ANDERSON, R. H., Decontamination of ships surfaces. II., 16: 16611 (USNRDL-TR-549)
ANDERSON, W. J., Carbon transfer in liquid Na systems, 16: 16682 (TID-7626(Pt.I)(p.92-100))
ANDREEV, S. V., Radiation in plant protection, 16: 16110
ANGHILERI, L. J., Stability of labeled Na polymetaphosphate, 16: 16414
ANKUDINOV, E. P., Determination of radioactivity in water, 16: 16325
ANSARI, R., On the phase-space integral, 16: 17020
ANTILL, J. E., Oxidation of Magnox A12, 16: 16696
ANTUF'EV, Yu. P., Resonances in $Si^{29}(p,\gamma)P^{30}$ reaction, 16: 17145
APFEL, Joseph, Acoustic thermometry, 16: 16558
APPEL, H., Beta decay of Nb-95, 16: 17085
APPEL, J., Prog. rpt. on high-temperature semiconductors, 16: 16799 (AD-265462)
APPLEBY, D. B., Plastic scintillator whole-body counter, 16: 16137
ARAJS, Sigurds, Specific heats of Ce, Nd, and Sm, 16: 16746
ARHELGER, R. B., Response of rabbits to nephrotoxic serum, 16: 16195
ARMSTRONG, R. L., Rotational states of polar molecules in rare gas crystals, 16: 16330 (AD-264708)

ARMSTRONG, W. D., Nervous system in radiation damage, 16: 16282
ARNOLD, G. P., Neutron diffraction studies on Eu, 16: 16836
ARONIN, L. R., Performance of operational fuel elements, 16: 16669
ARONIN, L. R., Plutonium and its alloys, 16: 16658
ARSENAULT, Claudette, Millibeam irradiations on mammalian tissue, 16: 16190
ARTHUR, B. W., Metabolism of insecticides in animals, 16: 16113
ASH, W. J., Water cooled retort cover, 16: 16673
ASTIER, A., K_2^0 decay in a Wilson chamber, 16: 16954 (NP-11592(Vol.I)(p.227-34))
ASUNDI, R. K., Band spectrum of CuCl molecule. II., 16: 16345
ASUNDI, R. K., Band spectrum of CuCl molecule. III., 16: 16346
ATAKA, Yasusi, Yukawa and Fermi interactions, 16: 17041
ATEN, A. H. W., Jr., Shape of fission yield curve, 16: 17126
ATHAY, R. Grant, Equilibrium in chromospheric Mg I, Ca I, and O I, 16: 16898
ATTIX, Frank H., Ionization chamber for source calibrations, 16: 16554
AUBERT, B., β decay of Λ^0 and Σ hyperons, 16: 16951 (NP-11592 (Vol.I)(p.197-200))
AUBERT, H., Cathodic oxidation of uranium, 16: 16694
AUDRAN, Roger, Analysis of photographic emulsions, 16: 16362
AUSTERN, N., A three-body model of Li-6, 16: 17079
AUSTIN, G. M., Radiation effects on spinal cord of cat, 16: 16262
AVAN, L., "Incorporated target" technique with nuclear emulsions, 16: 16967 (NP-11592(Vol.I)(p.307-25))
AVAN, M., "Incorporated target" technique with nuclear emulsions, 16: 16967 (NP-11592(Vol.I)(p.307-25))
AYSCOUGH, P. B., Alkyl radicals in γ-irradiated alkyl halides, 16: 16438
AZAM, Noel, Segregation of impurities in Be, 16: 16740
AZIMOV, S. A., Proton-proton elastic scattering at 2.8 Bev, 16: 17050

B

BABAEV, A. I., Decay $\mu \to e + \gamma$, 16: 17056
BACHOFER, C. S., Radiation effects on isolated nerves, 16: 16255
BACHOFER, C. S., X-ray induction of electroretinogram, 16: 16259
BACKENSTOSS, G., Scattering of μ mesons on electrons, 16: 16945 (NP-11592(Vol.I)(p.147-50))
BACON, James F., Scintillator, 16: 16894
BACONNIER, Yves, Design of nuclear free-precession magnetometer, 16: 16519 (CEA-1931)
BACQ, Z. M., Radioprotective properties of oxytocin, 16: 16199
BAIN, A. S., Irradiation of UO_2 specimens, 16: 16775 (CRFD-1044)
BAIN, E. C., Effects of Nb on steel, 16: 16737
BAINBRIDGE, A. E., Levels of tritium in New Zealand, 16: 16078
BALACHANDRAN, A. P., Axial vector renormalization in β-decay, 16: 17124
BALACHANDRAN, A. P., K meson-pion scattering, 16: 17025
BALATS, M. Ya., Decay $\mu \to e + \gamma$, 16: 17056
BALDOCK, P., Compound in the U–Fe–C system, 16: 16757
BALL, Robert C., Prog. rpt. on productivity in stream ecosystems, 16: 16172 (TID-15385)
BANASEVICH, S. N., Chemical state of P-32 in irradiated KCl, 16: 16411 (AEC-tr-5055)
BANCAUD, J., Therapeutic use of radioisotopes, 16: 16245
BANKS, C. J., Feeding behavior of phytophagous insects, 16: 16121
BANKS, Ephraim, Rare earth disilicides, 16: 16377
BARA, Hideo, Preparation of high-purity silicon, 16: 16075
BARASHENKOV, V. S., Peripheral interactions of fast particles, 16: 17016
BARBASHOV, B. M., Low equation for a local field theory model, 16: 17224
BARBER, Edda, Bibliography on thermionic and thermoelectric conversion, 16: 17315 (JPLAI-LS-392)
BARCHET, Reinhold J., Fuel element for nuclear reactors, 16: 17283
BARKER, R., Radiolysis of liquid cyclohexane, 16: 16431
BARLOUTAUD, R., Pion production by π^+, 16: 16930 (NP-11592 (Vol.I)(p.27-35))
BARLOUTAUD, R., Proton scattering in region 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))
BARNES, D., Technical photography of surface motion, 16: 16528 (VUP-2202)
BARNETT, C. F., Plasma potential measurements, 16: 17187
BARNETT, Harold M., Lead zirconate-lead titanate system, 16: 16743
BARR, L. W., Diffusion in surface of a metal, 16: 16045
BARR, Nathaniel F., Absorbed dose in water, 16: 16555
BARRANCO, Sam, Irradiation dose estimation, 16: 16238
BARRETT, L. G., Exponential experiments on D_2O–H_2O moderated lattices, 16: 17228 (BAW-1233)
BARTOCCI, A., Components for SENN vessel, 16: 17303
BARTON, John A., Radiation at the lunar surface, 16: 17329
BARYAKHTAR, V. G., Electron relaxation and electric conductivity of a plasma, 16: 17209
BASCHIERI, Ivo, Distribution of radioisotopes in the system, 16: 16142
BASERGA, Renato, Irradiation effects on rat bones, 16: 16194
BASHANDY, E., Decay of Lu-177 to Hf-177, 16: 17093
BASHANDY, E., Pure E2 transition in Hg-196, 16: 17100
BASHKIN, Stanley, Cluster model and nuclear transmutation, 16: 17073 (SUI-61-6)
BASKOVA, K. A., Radioactive nuclei in region of filled $1f_{7/2}$ shell, 16: 17148
BASSO, P., Reactivity changes in natural U graphite lattices, 16: 17244
BATES, D. R., Effect of Coulomb repulsion, 16: 16869
BATZER, Thomas H., Fast acting current switch, 16: 17219
BAUMANN, Elizabeth V., Prog. rpt. on miniature purification. I., 16: 16335 (DP-678)
BAUMANN, G., Emission of Li-8 and B-8 fragments in proton-emulsion interactions, 16: 16940 (NP-11592(Vol.I)(p.117-20))
BAUSA, W. E., Once-through steam producers for reactors, 16: 16509
BEACH, S. A., X-ray dose delivered to thyroids of children, 16: 16218
BEALE, D., Determination of amino acids, 16: 16089
BEARD, J. R., Phospholipids of dieldrin-resistant houseflies, 16: 16118
BEATTIE, H. J., Aging reactions in René 41, 16: 16718 (DF-59-SL-314)
BEAUMARIAGE, M. L., Radioprotective properties of oxytocin, 16: 16199
BEAVER, R. J., Brazing alloys for stainless steel fuel elements, 16: 16675 (ORNL-2834)
BEELER, J. R., FORTRAN Monte Carlo program. I., 16: 16633 (DC-59-12-83)
BEERS, Yardley, Hfs in rotational spectrum of HDO, 16: 16355
BEERWALD, H., Structure of electrodeless ring discharge, 16: 17176 (JUL-33-PP)
BEHR, J. v[on], Reabsorption of fast secondaries in nuclei, 16: 17123
BEIBUTOV, Sh. M., Changes in cardiovascular system associated with Ra therapy, 16: 16208
BELCHER, E. H., Whole-body counting in clinical studies, 16: 16158
BELFORD, Geneva G., Diffusion kinetics in radiation chemistry. II., 16: 16416
BELLINI, G., Low-multiplicity jets produced by high-energy pions, 16: 16986 (NP-11592(Vol.I)(p.453-7))
BELLINI, G., Momentum spectrum of slow protons, 16: 16985 (NP-11592 (Vol.I)(p.449-52))
BELOPUKHOV, L. K., Cinematography of underground explosions, 16: 16033 (UCRL-Trans-806(L))
BELOV, K. P., Magnetostriction of Dy, 16: 16882
BELYAEV (BELYAYEV), A. I., Study of fused salts with radiation, 16: 16342 (FTD-TT-62-46)
BEN DANIEL, David J., Ionization in cesium discharges, 16: 16856
BENEVENTANO, M., Photoproduction of π^+ mesons in H_2, 16: 16928 (NP-11592(Vol.I)(p.21-4))
BENIOFF, Paul A., Nucleon-nucleus scattering, 16: 17121
BENIS, A. M., Cost of processing stainless steel-jacketed UO_2 fuel, 16: 16457 (ORNL-3227)
BENISTON, M. J., Hyperfragments from interactions of K^- mesons with emulsion nuclei, 16: 16976 (NP-11592(Vol.I)(p.363-9))
BENNETT, J. A., Measurement of film thickness, 16: 16622
BENNETT, L. L., Effect of reduced U-235 price on fuel costs, 16: 17298 (ORNL-TM-191)
BENNETT, Winifred, Radiation-induced oxidation of protein, 16: 16439
BENOIT, R., Determination of Rhodamine B, 16: 16320
BENSON, G. C., Surface energies of fluorite structure, 16: 16386
BENZ, R., Pu(IV)-alkali double chlorides, 16: 16367
BERENYI, D., Decay scheme of I-131, 16: 17117
BERENYI, Denes, Beta-ray band spectrograph. I., 16: 16536
BERENYI, Denes, Beta-ray band spectrograph. II., 16: 16537
BERENYI, Denes, Beta-ray band spectrograph. III., 16: 16538

BEREZINSKII, V. S., Polarization of cosmic μ mesons, 16: 16921
BERGEDER, H. D., Action mechanism of ionizing radiation, 16: 16287
BERGHAMMER, J., Landau damping of space-charge waves, 16: 16843
BERGSTROEM, R. M., Effect of α particles on frog sciatic nerve, 16: 16197
BERNARD, Y., Blood volume of rat using Cr-51, 16: 16103 (CEA-2112)
BERNHARD, Fritz, Photomultiplier tubes and scintillation apparatus, 16: 16531 (UCRL-Trans-786(L))
BERNSTEIN, M., Theorems in magnetohydrodynamics, 16: 17330
BERRY, P. F., Leaks in sealed components, 16: 16071
BERTAUT, E. F., Magnetic structure work at Grenoble, 16: 16834
BERTAUT, E. F., Rare-earth ruthenates, 16: 16837
BERTIN, P. Y., "Incorporated target" technique with nuclear emulsions, 16: 16967 (NP-11592(Vol.I)(p.307-25))
BERTINA, L. E., Beryllium. Chemical technology and metallurgy, 16: 16771
BERTOLINI, G., Excited states of Tl-208 and Po-212, 16: 17082
BESNARD, S., Penetration of sulfur into iron, 16: 16051
BEST, Bushnell, Process for graphite purification, 16: 16465
BEYERLE, Konrad, Centrifuges for separation of isotopes, 16: 16630
BHAT, A. N., Uranium(VI)-3-acetyl-4-hydroxycoumarin complex, 16: 16368
BIAGINI, C., Higher activity of nervous system, 16: 16283
BIALKOWSKI, Grzegorz, Dispersive bonds, 16: 17031
BIBRON, R., Measuring low level tritium, 16: 16097
BICHSEL, H., Positron polarization in Fermi-type transition, 16: 16059
BIGGS, S. L., Effects of radiation on enzymatic activity, 16: 16219
BIGHAM, C. B., Neutron spectra in cylinder of hot moderator, 16: 17233 (CRRP-985-D)
BILQUEZ, A. F., Radiation of production of new plant varieties, 16: 16205
BINOPOULOS, D., Whole-body counting in clinical studies, 16: 16158
BIRBRAIR, B. L., Proton-neutron interactions in pair correlation model, 16: 17150
BIRCH, Stanley Francis, Radiation-resistant lubricants, 16: 16797
BIRD, P. M., Radioactive fallout study, 16: 16598 (CNHW(RP-4))
BISHOP, J. F. W., Effect of neutron irradiation in U, 16: 16796
BISHOP, K. F., Tritium of atmospheric methane, 16: 16079
BISSON, Andre, Electron microscope study of BeO, 16: 16735 (AEC-tr-5028)
BLACKBURN, D. A., Diffusion in surface of a metal, 16: 16045
BLACKBURN, D. A., Diffusion in moving grain boundaries, 16: 16046
BLAND, William H., Determination of total-body K, 16: 16157
BLANC, Daniel, Reaction $Si^{28}(n,\alpha)Mg^{25}$ at 14.6 Mev, 16: 17076
BLANCHARD, Monique, Attack of Mo by liquid Ce, 16: 16693
BLANK, A. A., Collisionless shock theory, 16: 16913
BLAQUIERE, A., Fluctuations in system depending on random parameters, 16: 17231 (CEA-2115)
BLAQUIERE, Austin, Neutron noise in nuclear reactors, 16: 17230 (CEA-1855)
BLASKOVIC, L., K_2^0 decay in a Wilson chamber, 16: 16954 (NP-11592 (Vol.I)(p.227-34))
BLATTER, R., Beta decay of Nb-95, 16: 17085
BLEWITT, T. H., Resistivity of sodium, 16: 16789
BLINCOE, Clifton, Determination of cesium in tissues, 16: 16165
BLOCK, M., Three-pion resonances in π^+-D reactions, 16: 16962 (NP-11592(Vol.I)(p.277-82))
BLOOM, Stewart D., Beta decay of Sc-44, Zr-95, and Nb-95, 16: 17084
BLOSSER, T. V., Shield of Illinois Univ. Triga Mark II reactor, 16: 17310 (ORNL-TM-178)
BOARDMAN, A. D., Propagation of gravity waves along conducting fluid, 16: 16899
BOCK, E., Bibliography on (n,n) and (n,2n) reactions, 16: 17074 (VDIT-50)
BOCK, I. E., Axial flux in lattice position in NRX, 16: 17232 (CRC-1058)
BOCQUET, M., Mercury porosimeter for nuclear graphite, 16: 16521 (CEA-2093)
BODMER, A. R., Binding energies of Λ particles, 16: 17015
BODMER, A. R., Imaginary part of optical potential, 16: 17104
BODNAR, L. H., Diffusion coefficients of gases, 16: 16351
BOEER, K. W., Additive coloring of Sr fluoride, 16: 16860
BOEER, K. W., Electroluminescence of CdS single crystals, 16: 16858
BOGDANOV, R. V., Chemical state of P-32 in irradiated KCl, 16: 16411 (AEC-tr-5055)
BOGLE, G. S., Splitting of Gd sulfate octohydrate, 16: 16384
BOGOYAVLENSKAYA, M. P., Properties of blood during Rn therapy, 16: 16290
BOHM, D., New isobaric spin group, 16: 16990 (NP-11592(Vol.I)(p.503-6))
BOKSHTEIN, S. Z., Recrystallization and phase transformations, 16: 16050
BOLTAX, A., Behavior of fissionable material, 16: 16663
BOLTAX, A., Fission gas re-solution during heat treatment, 16: 16755
BONIS, A., Therapeutic use of radioisotopes, 16: 16245
BONNER, T. W., Neutron background from betatron, 16: 17158 (SCR-481)
BONNET, Georges, Demagnetizing devices, 16: 16485
BOOTH, A. H., Radioactive fallout study, 16: 16598 (CNHW(RP-4))
BORCHARDT, W., Photochemical reactions and quenching in CdS, 16: 16862
BORELLO, O., Photoneutron angular distribution, 16: 17089
BOSE, S. K., Decay rate of the neutral pion, 16: 17026
BOTSFORD, N. B., Explosive means to separate casing members, 16: 16494
BOULENGER, R., Air radioactivity in the Antarctic, 16: 16042
BOURDEAU, R. E., Instrumentation of ionosphere measurements satellite, 16: 17316 (NASA-TN-D-414)
BOURDILLAT, M. F., Control in nuclear power plants, 16: 17301
BOWDEN, D. C., Hand exposure time, 16: 16616
BOWEN, H. J. M., Effect of radiation on soils, 16: 16176 (NP-11578)
BOWERS, Vernon A., Structure of the formyl radical, 16: 16359
BOYCE, I. S., Liquid scintillation counter for T, 16: 16093
BOYD, A. W., Axial flux in lattice position in NRX, 16: 17232 (CRC-1058)
BOYD, Anne H., Effect of Coulomb repulsion, 16: 16869
BOYER, C. B., Gas pressure bonding, 16: 16701
BOYLE, J. W., Iron(III) molar extinction coefficients, 16: 16387
BRADBURY, B. T., Crystal habit of UO_2, 16: 16759
BRADER, I. M., Radiolabeling of ants, 16: 16111
BRADLEY, A., Packaged Pm^{147}-activated light sources, 16: 16621
BRADY, Luther W., Brain tumor localization by Hg-203, 16: 16231
BRAMBLETT, R. L., Neutron background from betatron, 16: 17158 (SCR-481)
BRAMBLETT, R. L., Positron annihilation at 15 Mev, 16: 17012
BRANCKER, A. V., Separation of heavy water, 16: 16628
BRANDELA, M., Resistance to thermal shock, 16: 16646 (EURAEC-194 (App.3))
BRANDENBERG, W., Analysis of cyclotron α particles, 16: 16542
BRANSDEN, B. H., On pion-pion scattering, 16: 16971 (NP-11592(Vol.I) (p.343-6))
BRASSARD, Theresa V., Preparing various graphites for examination, 16: 16761
BRAUN, Eberhard, Nuclear photoeffect on Al and F, 16: 17137
BRAUN, H., Emission of Li-8 and B-8 fragments in proton-emulsion interactions, 16: 16940 (NP-11592(Vol.I)(p.117-20))
BRAUN, Heribert, Ionizing radiation after previous hypoxia, 16: 16234
BRAUN, Hildegard, Cytoplasm of liver cells after irradiation, 16: 16235
BRAUN, W. J., Wear in large diesel engines, 16: 16062
BRAY, L. A., Recovery of Sr from Purex wastes, 16: 17333 (HW-69534)
BRETT, N. H., Sintering behavior in PuO_2–UO_2 system, 16: 16753
BREUER, M. M., Isotope separation by electrodiffusion, 16: 16629
BREWER, D. F., Sorption of He and N_2 on vycor porous glass, 16: 16385
BRIDGES, R. G., Phospholipids of dieldrin-resistant houseflies, 16: 16118
BRIGGS, G., Compound in the U–Fe–C system, 16: 16757
BRINKMAN, R., Radiobiology of nervous receptors, 16: 16254
BRISSON, J. C., Neutral processes in π^--p interaction, 16: 16932 (NP-11592(Vol.I)(p.45-55))
BRISSON, V., β decay of Λ^0 and Σ hyperons, 16: 16951 (NP-11592 (Vol.I)(p.197-200))
BRIVATI, J. A., Radicals in irradiated formates and oxalates, 16: 16435
BROCKLEHURST, J. E., Thermal expansion of graphite–Br compounds, 16: 16763
BRODER, D. L., Protective properties of water, polyethylene, and Plexiglas, 16: 17059
BRODY, J. K., Band spectrum of CuCl molecule. II., 16: 16345
BRODY, J. K., Band spectrum of CuCl molecule. III., 16: 16346
BROVETTO, P., End-windowed G-M counter, 16: 16545
BROWN, A. F., Diffusion in surface of a metal, 16: 16045

BROWN, A. F., Diffusion in moving grain boundaries, 16: 16046
BROWN, D., Properties of Pa(V) in H_2SO_4, 16: 16365
BROWN, Gordon, Improvements in nuclear reactors, 16: 17248
BROWN, P. J., Hyperfine fields in Fe_2Ti and Fe_2Zr, 16: 16833
BROWN, Sidney O., Irradiation dose estimation, 16: 16238
BROWN, W. L., Behavioral changes as radiation function, 16: 16267
BROWN, W. Richard, Prog. rpt. on thermal expansion of ceramics, 16: 16715 (CAL-PI-1273-M-10)
BROWNELL, Gordon L., Neutron therapy of operatively exposed gliomas, 16: 16250
BROWNELL, L. E., Effect of radiation on fruit fly eggs, 16: 16123
BROWNELL, L. E., Radiation sources for insect control, 16: 16126
BROWNING, Leslie S., Mutagenic effects of uv radiation in Drosophila, 16: 16201
BROWNING, Leslie S., Mutation rate and uv dose in Drosophila, 16: 16204
BRUNNER, G., Evaluation of γ scintillation spectrograms, 16: 16533
BRUNNER, J. H., Monoenergetic positrons in Bi-205, 16: 17096
BRUNNER, J. H., Monoenergetic positrons in Eu-152, 16: 17097
BRUNSON, J. G., Response of rabbits to nephrotoxic serum, 16: 16195
BRYUKHANOV, V. A., Mössbauer effect in tin-bearing polymer, 16: 16889
BUCHANAN, Archibald R., Biomedical effects of EM radiation. II., 16: 16174 (ASD-TR-61-195)
BUCHWALD, N. A., Radiation-conditioned behavior, 16: 16266
BUHL, P. A., Fission fragment damage in thin films, 16: 16787
BULL, V. A., Proton-proton elastic scattering, 16: 16936 (NP-11592 (Vol.I)(p.85-91))
BUNCE, J. E. J., Electric conductivity of Be, 16: 16749
BUNIN, B. G., Determination of radioactivity in water, 16: 16325
BURAGGI, G. L., Isotopic mixtures for *in vivo* measurement, 16: 16105
BURCH, P. R. J., Plastic scintillator whole-body counter, 16: 16137
BURGE, R. E., Electron scattering cross sections, 16: 16866
BURHOP, E. H. S., Hyperfragments from interactions of K^- mesons with emulsion nuclei, 16: 16976 (NP-11592(Vol.I)(p.363-9))
BURR, J. G., Tritium and D in organic radiation chemistry, 16: 16086
BURRILL, E. A., Application of accelerators to nondestructive testing, 16: 17162
BURROWS, Belton A., Clinical body counter for long-term Na studies, 16: 16156
BURTT, Benjamin P., Prog. rpt. on radiation-induced gas reactions, 16: 16409 (TID-15424)
BURYAK, E. M., Magnetic properties of β UH_3 and UD_3, 16: 16769
BUSSE, Ferdinand, Manufacturing helically finned tubing, 16: 16704
BUSSE, Warren Froemming, Process for modifying polymers, 16: 16446
BUTLER, Thomas A., Decontamination of uranium, 16: 16471
BUTT, D. K., Coincident γ rays of Pt-194, 16: 17118
BUZZATI-TRAVERSO, A. A., Control of populations, 16: 16129

C

CABLE, J. W., Magnetic ordering in thulium, 16: 16835
CABLE, J. W., Neutron diffraction of Pd and Fe group alloys, 16: 16839
CAIN, William Dennis, Signal recording and display arrangements, 16: 16561
CALIMANI, E., Selection rule $\Delta Q = \Delta S$, 16: 16953 (NP-11592(Vol.I) (p.209-15))
CALLER, J. M., Cable connector, 16: 16495
CALVERT, J. M., Reaction $B^{11}(\alpha,n)N^{14}$, 16: 17119
CAMBEL, Ali Bulent, Equation for perfect gas plasma, 16: 17186
CAMBOU, Francis, Fast-neutron spectroscopy methods, 16: 16520 (CEA-2002)
CAMBOU, Francis, Reaction $Si^{28}(n,\alpha)Mg^{25}$ at 14.6 Mev, 16: 17076
CAMERINI, W., Selection rule $\Delta Q = \Delta S$, 16: 16953 (NP-11592(Vol.I) (p.209-15))
CAMERON, J. F., Leaks in sealed components, 16: 16071
CAMERON, J. F., Liquid scintillation counter for T, 16: 16093
CAMPBELL, E. C., Fast pneumatic transfer tube, 16: 17313
CAMPBELL, R. B., Study of reactions of metals, 16: 16054
CAMPBELL, R. B., Tracers in lubrication research, 16: 16063
CAMPBELL, Ronald Hugh, Position indicating apparatus, 16: 17271
CAPE, J. A., Prog. rpt. on refractory materials, 16: 16733 (WADD-TR-60-581(Pt.II))
CAPPELLANI, F., Excited states of Tl-208 and Po-212, 16: 17082
CARABATEAS, E. N., Operation of Cs thermionic converters, 16: 16842
CARLSON, E. A., Mutagenesis in Drosophila. I., 16: 16202
CARLSON, R. R., Reaction $P^{31}(p,\gamma)S^{32}$, 16: 17090
CARLSON, Walter Berndt, Improvements in nuclear reactors, 16: 17249
CARLSTON, C. W., Tritium studies in Geological Survey, 16: 16081
CARPENTER, James F., Prog. rpt. on UO_2 powders, 16: 16730 (ORO-543)
CARR, C. I., Prog. rpt. on radiation-resistant materials, 16: 16707 (AD-265319)
CARRARA, R., Pion production by π^+ on protons, 16: 16929 (NP-11592 (Vol.I)(p.25-6))
CARRINGER, E. M., Astonautics information, Vol. 3, No. 3, 16: 17318 (NP-11493)
CARROLL, M. E., Jr., Pesco pump in 2000 gpm water loop, 16: 16479 (TIM-438)
CARTER, E. H., Jr., Separation of H, T, and HT, 16: 16085
CARTER, Joseph C., Reactor having NaK–UO_2, 16: 17281
CASIDA, J. E., Metabolism of insecticides by plants, 16: 16112
CASPARI, M. E., Electronic relaxation in Sm^{3+} in EuIG, 16: 16832
CASSEN, Benedict, Determination of total-body K, 16: 16157
CASTER, W. O., Nervous system in radiation damage, 16: 16282
CASTLE, J. E., Oxidation of Magnox A12, 16: 16696
CATANZARO, Edward J., Isotopic geochemistry, 16: 16577 (TID-14861 (Vols.I and II))
CATER, Donald B., Irradiation effects on rat bones, 16: 16194
CATOGGIO, Jose A., Determination of niobium, 16: 16327
CATOGGIO, Jose A., Determination of tantalum, 16: 16328
CATTERALL, J. A., Soft x-ray emission spectra from Cu_3Au, 16: 16867
CAVALIERE, A., Non-linear plasma oscillations, 16: 17192
CAVALLINI, A., Calibration of film badges, 16: 16615
CAWSE, P. A., Effect of radiation on soils, 16: 16176 (NP-11578)
CEDERQUIST, E. S., Clinical use of NaI(Tl) body counter, 16: 16161
CEMBER, Herman, Lung cancer in rats from radioactive Ce, 16: 16177 (NYO-10056)
CEOLIN, M. Baldo, Selection rule $\Delta Q = \Delta S$, 16: 16953 (NP-11592(Vol.I) (p.209-15))
CERRE, Pierre, Storage of plugs and devices from reactors, 16: 17331 (CEA-2084)
CHADWICK, G. B., Antiproton annihilation into two charged pions, 16: 16961 (NP-11592(Vol.I)(p.269-75))
CHADWICK, G. B., Inelastic p-p scattering, 16: 16983 (NP-11592(Vol.I) (p.419-25))
CHAIKIN, P. I., Determination of $MsTh_1$, 16: 16323
CHALLENDER, Ronald Scott, Improvements in pressure vessels, 16: 17250
CHAMBERLAIN, W. F., Metabolism of insecticides in animals, 16: 16115
CHAMBERLAIN, W. F., Radiation in insect control, 16: 16127
CHAMPENEY, D. C., Sorption of He and N_2 on vycor porous glass, 16: 16385
CHANDLER, W. T., Alkali metal corrosion studies at Rocketdyne, 16: 16678 (TID-7626(Pt.I)(p.42-62))
CHANEY, John E., Evaluation of chemical dosimeters, 16: 16529 (WT-753)
CHANTRY, G. W., Irradiated crystalline sodium formate, 16: 16430
CHAPIRO, Adolphe, Process for making graft copolymers, 16: 16449
CHAPLIN, R. L., Low-temperature radiation damage studies, 16: 16795
CHARLES, Michael P., Electron gun-molecular beam instrument for free radical studies, 16: 16781 (WADD-TN-60-251)
CHASE, Herman B., Millibeam irradiations on mammalian tissue, 16: 16190
CHEBOTAREVA, E. D., Ratio of radioactive erythrocytes and blood plasma, 16: 16169
CH'EN, Tsung-mo, Pion-pion interaction, 16: 17052
CHENEBAULT, P., Furnace for preparing powders of UO_2, 16: 16644 (EURAEC-194(App.1))
CHENG, H. S. Y., Prog. rpt. on stability of spherical shells, 16: 16472 (AROD-2465:1)
CHENOUARD, J., Formation of gases and H_2O_2 in Triton water, 16: 16332 (CEA-2088)
CHENOWETH, D. R., Magnetogasdynamic aspects, 16: 16812 (SCR-439)
CHERNAVSKII, D. S., Interference between amplitudes of inelastic processes, 16: 17055
CHERN'II (CHERNYI), G. G., Turbulent flow of compressed gas in channels, 16: 16507 (UCRL-Trans-785(L))

CHERRY, L. V., Compounds between cobalt and lanthanide elements, 16: 16742
CHERRY, L. V., Phases in lanthanon–manganese systems, 16: 16744
CHHABRA, A. S., Whole-body counter at Trombay, 16: 16145
CHIAVASSA, E., End-windowed G-M counter, 16: 16545
CHIDLEY, B. G., Neutron spectra in cylinder of hot moderator, 16: 17233 (CRRP-985-D)
CHIN, P. H., Skin transplants and blood cells of donor bone marrow, 16: 16178 (USNRDL-TR-553)
CHING, Cheng-jui, Phosphorus-32 β spectrum, 16: 17143
CHOQUET, C., Pion production by π^+, 16: 16930 (NP-11592(Vol.I)(p.27-35))
CHOQUET, C., Proton scattering in region 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))
CHRISTOFILOS, Nicholas C., Trapping electrons in magnetic field, 16: 17220
CHUEV, V. I., Spectra of tritons in reactors, 16: 16090
CIAMPOLILLO, S., Selection rule $\Delta Q = \Delta S$, 16: 16953 (NP-11592(Vol.I)(p.209-15))
CLARK, David J., Techniques of magnetic field measurement, 16: 17165
CLAYTON, C. G., Measurement of gas flow, 16: 16073
CLEGG, A. B., Bombardment of O-16 and F-19 with protons, 16: 17088
CLELAND, J. W., Recoil effects in semiconductors, 16: 16056
CLIFFORD, Warren E., Catalyzed oxidation of U, 16: 16454
COATES, G. E., Bipyridyl complexes of Be, 16: 16382
COCCONI, G., Elastic and inelastic p-p scattering, 16: 16981 (NP-11592(Vol.I)(p.397-406))
COCCONI, V. T., Antiproton-proton total cross sections, 16: 16963 (NP-11592(Vol.I)(p.283-6))
COCHRAN, Edward L., Structure of the formyl radical, 16: 16359
COGGESHALL, Norman D., Crossed-field ion sources, 16: 16846
COHN, S. H., Whole-body gamma spectrometry, 16: 16159
COLE, Dandridge M., Propelling vehicles by nuclear explosions, 18: 17328
COLE, G. H. A., Fifth virial coefficient for hard-sphere gas, 16: 16847
COLEMAN, L. F., Release of radiostrontium from strontium carbonate, 16: 16336 (HW-69692)
COLLINS, G. B., Inelastic p-p scattering, 16: 16983 (NP-11592(Vol.I)(p.419-25))
COLLONGUES, Robert, Phases from action of ammonia on zirconia, 16: 16350
COLOMBO, R., Uranium metal in fused UO$_2$, 16: 16758
COLTMAN, R. R., Resistivity of sodium, 16: 16789
COLVIN, R. V., Specific heats of Ce, Nd, and Sm, 16: 16746
COMBE, J. C., Bending high-energy particles in nuclear emulsions, 16: 16966 (NP-11592(Vol.I)(p.301-5))
CONGDON, C. C., Splenic white pulp alteration after antigen injection, 16: 16196
CONNOLLY, A., Thermal conductivity of Ta and Nb, 16: 16874
CONSTANS, J. P., Histological changes following cerebral implantation of gamma isotopes, 16: 16251
CONSTANS, P., Therapeutic use of radioisotopes, 16: 16245
CONSTANTINIDES, C., Whole-body counting in clinical studies, 16: 16158
CONTE, A., Recovery of Cs from fission product solutions, 16: 17337
CONTE, Rene, Recovery of radioinduced faults in Fe, 16: 16783
COOK, Gerhard A., Emission spectrometer, 16: 16570
COOK, V., K$^+$-nucleon total and differential cross-sections, 16: 16957 (NP-11592(Vol.I)(p.247))
COOPER, J., Total-radiation detector, 16: 16540
COPESTAKE, T. B., Reaction between C and CO$_2$ under irradiation, 16: 16407 (NPCC/MWP(G)/P157)
CORATO, M. Di, V^0 pairs produced in propane bubble chamber, 16: 16938 (NP-11592(Vol.I)(p.101-10))
CORDEIRO, S., Method for sand labeling, 16: 16586
CORLISS, Charles H., Tables of spectral-line intensities, 16: 16337 (NBS-MON-32(Pt.II))
CORNEY, N. S., Reaction between C and CO$_2$ under irradiation, 16: 16407 (NPCC/MWP(G)/P157)
CORTES, F. R., Working properties of Nb, 16: 16747
CORZINE, P. D., Fabrication of core materials, 16: 16665
COSTOMIRIS, George, Sodium–K alloy to Hg boiler, 16: 16502 (FXM-208)
COTTINGHAM, W. N., On nucleon-nucleon potential, 16: 16972 (NP-11592(Vol.I)(p.347-9))
COURANT, R., Methods of mathematical physics. II., 16: 16640
COURTOIS, G., Studying wear of refactory linings, 16: 16066
COURTOIS, G., Transport of solids in water courses, 16: 16070
COUSINS, J. E., Momentum spectrum of μ mesons, 16: 16919
COWPER, M. J., Accident probability due to reactor protective system failure, 16: 16595 (AHSB(S) R-35)
COX, Raymond John, Improvements in ionization chamber circuits, 16: 16563
CRABBE, J. B., Reactor assembly and auxiliary systems, 16: 17289 (DC-55-11-25)
CRAMER, R. A., Magnetic tape for evaluation of γ spectra, 16: 16153
CRAWFORD, J. H., Jr., Recoil effects in semiconductors, 16: 16056
CREMIEU-ALCAN, E., Conference on elementary particles, Aix-en-Provence, Sept. 1961, 16: 16925 (NP-11592(Vol.I))
CREMIEU-ALCAN, E., Conference on elementary particles, Aix-en-Provence, Sept. 1961, 16: 16993 (NP-11592(Vol.II))
CRESTI, M., Antiproton annihilation into two charged pions, 16: 16961 (NP-11592(Vol.I)(p.269-75))
CRESTI, M., Pion production by π^+ on protons, 16: 16929 (NP-11592(Vol.I)(p.25-6))
CRESTI, M., Proton scattering in region 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))
CREVER, Frederick E., Control system for neutronic reactors, 16: 17279
CRIBIER, Daniel, Spectroscopy of Fe(II) in FeCl$_2$, 16: 16824
CRICKMORE, M. J., Measurement of sand transport, 16: 16588
CRIGLER, A. W., Process for applying ceramic and cermet coatings, 16: 16641 (ARL-59)
CROLL, Millard N., Brain tumor localization by Hg-203, 16: 16231
CRONE, H. D., Phospholipids of dieldrin-resistant houseflies, 16: 16118
CRONKITE, E. P., Whole-body gamma spectrometry, 16: 16159
CROSBY, J. J., Compatibility of containment metals with Cs, 16: 16684 (TID-7626(Pt.I)(p.109-10))
CSEJTHEY-BARTH, M., Hyperfragments from interactions of K$^-$ mesons with emulsion nuclei, 16: 16976 (NP-11592(Vol.I)(p.363-9))
CUER, P., Emission of Li-8 and B-8 fragments in proton-emulsion interactions, 16: 16940 (NP-11592(Vol.I)(p.117-20))
CULLIGAN, G., Decay rate of negative muons, 16: 16944 (NP-11592(Vol.I)(p.143-5))
CUMMINGS, David B., Fast acting current switch, 16: 17219
CUPERMAN, S. A., Pseudoscalar interaction in $\frac{1}{2}+ \rightarrow \frac{1}{2}- \beta$ decay. II., 16: 17080
CURTIS, A. R., FORTRAN for autocode programmers—AUTOTRAN, 16: 16631 (AERE-R-3980)
CURTIS, H. J., Histochemical studies on mouse brains, 16: 16276
CUVIER, Georges, Problems of the radioactivity of food, 16: 16617
CVIJANOVIC, G., Elastic scattering of protons on H$_2$, 16: 16939 (NP-11592(Vol.I)(p.111-15))
CYPRIEN, Jules, Improvements in ionization chambers, 16: 17216
CZAPEK, G., Elastic scattering of protons on H$_2$, 16: 16939 (NP-11592(Vol.I)(p.111-15))
CZUBEK, J., Potassium salts prospecting, 16: 16044
CZYZ, W., Pion-nucleon collisions, 16: 17014

D

DABBS, J. W. T., Nuclear orientation experiments, 16: 16061
DALITZ, R. H., Strange particle physics, 16: 17003 (NP-11592(Vol.II)(p.151-75))
DANIEL, H., Beta spectrum of RaE, 16: 17105
DANIEL, H., Coil arrangement for β spectrometer, 16: 16550
DANIELS, Robert E., Stable electronic integrator switch, 16: 17169
DANKO, J. C., Mixed valence thermoelectric materials, 16: 16734 (WCAP-1655)
DANON, F., Corresponding states theory for Ar and Xe, 16: 16374
DANTL, Gerhard, Thermal expansion of H$_2$O and D$_2$O single crystals, 16: 16879
DARRAS, R., Chemical stability of metallic elements, 16: 17245
DARRAS, Raymond, Kinetics of oxidation of Mg in humid O$_2$, 16: 16348
DARWIN, George Erasmus, Improvements in nuclear fuel elements, 16: 17257
DARWIN, George Erasmus, Improvements in fuel elements, 16: 17258
DAS, P., Lambda curves of He-3–He-4 mixtures, 16: 16865

DAUBE, J. R., Effects of uv and ionizing radiations on nerve, 16: 16256
DAUTREPPE, Daniel, Ordered Fe–Ni structure from neutron irradiation, 16: 16782
DAVIDSON, H. W., Properties of impermeable carbon, 16: 16765
DAVIDSON, William N., High temperature radiation tolerant component program, 16: 16777 (DC-58-4-71)
DAVIES, J. Tudor, Magnetostriction of Gd metal, 16: 16873
DAVIES, W. T., Antiproton annihilation into two charged pions, 16: 16961 (NP-11592(Vol.I)(p.269-75))
DAVIES, W. T., Pion production by protons in hydrogen, 16: 16984 (NP-11592(Vol.I)(p.433-47))
DAVIS, D. H., Hyperfragments from interactions of K^- mesons with emulsion nuclei, 16: 16976 (NP-11592(Vol.I)(p.363-9))
DAVIS, R. E., Assessment of iodine-in-milk levels following reactor accident, 16: 16594 (AEEW-R-138)
DAVIS., R., Jr., Meteorites as space probes, 16: 16038
DAVISON, W. H. T., Study of metal deformation, 16: 16055
DAWSON, John, One-dimensional plasma model, 16: 17195
DAWSON, K. B., Frog nerve-muscle following irradiation, 16: 16257
DAYTON, Russell W., Prog. rpt. on civilian applications, 16: 17229 (BMI-1565(Del.))
DEAN, O. C., Preparation of Th oxide particles, 16: 16404
DE BERGEVIN, F., Magnetic structure work at Grenoble, 16: 16834
DE BROGLIE, L., New isobaric spin group, 16: 16990 (NP-11592(Vol.I)(p.503-6))
DE BRUYN OUBOTER, R., Lambda curves of He-3–He-4 mixtures, 16: 16865
DE BUSK, A. Gib, Genetic studies in lower radiation belt, 16: 16191
DECONNINCK, G., Heavy ions, 16: 17134
DE COULON, G. A. G., Spectral shift control reactor physics, 16: 17286 (BAW-1230(Pt.III))
DE COURREGES, M. M., K_1^0 decay in a Wilson chamber, 16: 16954 (NP-11592(Vol.I)(p.227-34))
DEERING, R. A., Effects of accelerated heavy ions, 16: 16189
DEICHMAN, E. N., Plutonium fluorides, 16: 16392
DELAFIELD, H. J., Tritium of atmospheric methane, 16: 16079
DE LA HARPE, A., Burnout heat fluxes for two-phase water–steam in forced convection, 16: 16499 (CEA-Bib-28)
DELAPALME, A., Magnetic structure work at Grenoble, 16: 16834
DELAROUSSE, P., Control of concentration in gaseous diffusion plant, 16: 16626 (CEA-2010)
DELATTRE, R., Control other than by insecticides, 16: 16128
DELCROIX, J. L., Theory of waves in plasma, 16: 17211
DE LEONE, R., Determination of B, Al, Fe, Mn, and Cr in U, 16: 16304 (CNEN-96)
DELIBRIAS, G., Measuring low level tritium, 16: 16097
DELL, John David, Improvements in nuclear reactors, 16: 17249
DELYAGIN, N. N., Mössbauer effect in tin-bearing polymer, 16: 16889
DE MAYO, P., Irradiation of unsaturated sultones, 16: 16437
DEMIRKHANOV, R. A., Plasma instability in toroidal discharge, 16: 17206
DEMPSEY, E., Surface energies of fluorite structure, 16: 16386
DENISSE, J. F., Theory of waves in plasma, 16: 17211
DER BOGHOSIAN, Setrak, Radiography of uranium, 16: 16573 (WAL-TR-142.1/2)
DER MATEOSIAN, E., Nuclear data tables. IV., 16: 17154
DERRICK, M., Antiproton annihilation into two charged pions, 16: 16961 (NP-11592(Vol.I)(p.269-75))
DERRICK, M., Pion production by protons in hydrogen, 16: 16984 (NP-11592(Vol.I)(p.433-47))
DERYABINA, V. M., Influence of radon water on gastric function, 16: 16209
DE SIGOYER, B. Bernardi, Soldering of stainless steel tubes to Zy, 16: 16649 (EURAEC-194(App.6))
DES ROSIERS, Paul E., Jr., Water demineralization and decontamination, 16: 16603 (ERDL-1671-TR)
DETCEUF, J. F., Isobars of nucleons and π-meson resonance states, 16: 16998 (NP-11592(Vol.II)(p.57-85))
DE TIFFE, G., UO_2 sintering preliminary to irradiation, 16: 16648 (EURAEC-194(App.5))
DEUTSCH, A., Mass loss from stars, 16: 16907
DEUTSCH, M., Photoproduction of π^0 mesons in H_2, 16: 16926 (NP-11592(Vol.I)(p.9-15))
DEVILLERS, Danielle, Reaction $Si^{28}(n,\alpha)Mg^{25}$ at 14.6 Mev, 16: 17076
DE VRIES, C., Form factors of neutron and structure of nucleons, 16: 16941 (NP-11592(Vol.I)(p.121-37))
DEWEY, W. C., Radiosensitivity of mouse fibroblasts, 16: 16224
D'HOOP, H., Stabilization of Cockroft-Walton generator, 16: 17166
DI CHIRO, Giovanni, Radioactive localization of intracranial lesions, 16: 16247
DICK, L., Method for determining proton polarization, 16: 16965 (NP-11592(Vol.I)(p.295-9))
DIDDENS, A. N., Elastic and inelastic p-p scattering, 16: 16981 (NP-11592(Vol.I)(p.397-406))
DIEBNER, K., Converging shock waves for nuclear fusion, 16: 17190
DIEBNER, Kurt, Operation of nuclear reactors, 16: 17264
DIEBOLD, R., Photoproduction of ω^0 mesons from H_2, 16: 17065 (CTSL-32)
DIEFENDORF, R. J., Pyrolytic graphites, 16: 16760
DIESENDRUCK, L., EM fields of charge and isotropic medium, 16: 17009
DIETZ, L. A., Isotopic abundance measurements, 16: 16317
DI LUZIO, N. R., Irradiation zymosan administration, 16: 16226
DI PAOLA, M., Higher activity of nervous system, 16: 16283
DI PIETRANTONIJ, F., Bone marrow content of the human body, 16: 16107
DIRIAN, G., Formation of gases and H_2O_2 in Triton water, 16: 16332 (CEA-2088)
DIXMIER, J., Corrosion by UF_6. II., 16: 16695
DIXON, Charles E., Radiography of uranium, 16: 16573 (WAL-TR-142.1/2)
DMITRIEV, I. S., Alpha angular distributions from $Li^7(p,\alpha)He^4$, 16: 17141
DODD, P., Pion production by protons in hydrogen, 16: 16984 (NP-11592(Vol.I)(p.433-47))
DODE, Maurice, Nonstoichiometry of U oxides, 16: 16738
DOEDERLEIN, J. M., Theoretical analysis of SSCR. I., 16: 17227 (BAW-1230(Pt.I))
DOGGETT, W. O., Two connected nuclear transformations, 16: 17062 (AROD-2543:6)
DOLLE, L., Formation of gases and H_2O_2 in Triton water, 16: 16332 (CEA-2088)
DOLPHIN, G. W., X-ray dose delivered to thyroids of children, 16: 16218
DOME, G., Stabilization of Cockroft-Walton generator, 16: 17166
DOMOKOS, G., Elastic high-energy pion-pion scattering, 16: 17053
DOMOKOS, S., Scattering of pions and nucleons at high energies, 16: 17069 (JINR-D-922)
DONLEY, J. L., Instrumentation of ionosphere measurements satellite, 16: 17316 (NASA-TN-D-414)
DONZE, Gerard, Segregation of impurities in Be, 16: 16740
DOUGLASS, R. M., Pu(IV)-alkali double chlorides, 16: 16367
DOUIS, Michel, Improvements in remote control devices, 16: 16466
DOWELL, J. D., Hyperon production in π-p collisions, 16: 16979 (NP-11592(Vol.I)(p.385-8))
DOWKER, J. S., Note on a remark of Minami's, 16: 17049
DOWNS, B. W., Elementary theory of resonance scattering, 16: 17008
DRAGNEV, T. N., Proton energy and angular distributions from $Ca^{40}(\gamma,p)K^{39}$, 16: 17139
DRATH, Heinrich, Structures for protection against radiation, 16: 17223
DREIER, T., Training program in reactor engineering, 16: 17246
DRELL, S. D., High energy physics above 10 Bev, 16: 17001 (NP-11592(Vol.II)(p.125-39))
DREYFUS, Bernard, Recovery of radioinduced faults in Fe, 16: 16783
DUCLOS, Donald P., Equation for perfect gas plasma, 16: 17186
DUGGAL, S. P., Cosmic ray storm of July 1961, 16: 16917
DUKE, P. J., Inelastic p-p scattering, 16: 16983 (NP-11592(Vol.I)(p.419-25))
DUKOR, Peter, Protective action of oxytryptamine derivatives, 16: 16300
DUMESNIL, Patrice, Beryllium detection by (γ,n) reaction, 16: 16321
DUNAITSEV, A. F., Beta decay probability of π^+ meson, 16: 17057
DUNCAN, D., Energy absorption rates in OMR coolants, 16: 17236 (NAA-SR-6893)
DUNKLEE, Albert E., Coolant void reactivity coefficients, 16: 17234 (DP-641)
DUNN, Arthur L., Labeling pharmaceutical compounds, 16: 16443
DURAND, Georges, Measurement of isotopic ratios of Pb, 16: 16825
DURR, H.-P., Theory of strange particles, 16: 16947 (NP-11592(Vol.I)(p.163-8))

DUTREIX, J., Isotopic mixtures for *in vivo* measurement, 16: 16105
D'YACHKOVA, R. A., Separation of Pa from Zr, Ti, and Nb, 16: 16396
DYNE, P. J., Radiolysis of liquid cyclohexane, 16: 16426
DZANTIEV, B. G., Reaction of tritium recoil with benzene, 16: 16442
DZHELEPOV, V. P., Mesic atom processes in H_2, 16: 16884
DZHIBUTI, R. I., Photonuclear reaction $He^4(\gamma,np)D$, 16: 17149
DZHIKIDZE, E. K., Infections in monkeys with radiation sickness, 16: 16295
DZIUNIKOWSKI, B., Potassium salts prospecting, 16: 16044

E

EASTHAM, J. F., Scintillation detection of tritium, 16: 16091
EBATA, Takesi, Application of dispersion to K^+-p scattering, 16: 17047
EBEL, G., π-N forward scattering, 16: 16991 (NP-11592(Vol.I)(p.485-6))
EBERLE, A. R., Determination of Sn and Mo in materials, 16: 16314
ECCLES, S. F., Gamma spectroscopy of Cd-107, Pd-109, and Pd-111, 16: 17125
EDWARDS, John George, Fuel elements for reactors, 16: 17265
EFIMOV, G. V., Kemmer scalar symmetrical model, 16: 17068 (JINR-D-860)
EFIMOV, G. V., Low equation for a local field theory model, 16: 17224
EFREMOV, A. V., Highest partial waves in low energy approximation, 16: 17067 (JINR-D-857)
EGANA, E., Metabolic studies of CNS exposed to P-32 irradiation, 16: 16274
EGGLETON, A. E. J., Tritium of atmospheric methane, 16: 16079
EGLI, P., Elastic scattering of protons on H_2, 16: 16939 (NP-11592 (Vol.I)(p.111-15))
EGOROV, Ye. V., Sorption of isotopes by MnO_2, 16: 16389
EHRHARDT, P., Excretion of labeled phosphate in aphids, 16: 16122
EICHER, H., 84-Kev level in Yb-170, 16: 17135
EISENBERG, Y., Hyperon-pion resonances, 16: 16980 (NP-11592 (Vol.I)(p.389-94))
EISLER, F., Reaction $\pi^- + p \to \Lambda^0 + K^0$ at threshold, 16: 16952 (NP-11592(Vol.I)(p.203-7))
EKERT, B., Effect of γ rays on thymine, 16: 16432
EKSPONG, A. G., Antiproton interaction cross sections, 16: 16922 (AD-261903)
ELKO, E. E., Irradiation zymosan administration, 16: 16226
ELLINGER, F. H., Plutonium–Al phase diagram, 16: 16750
ELLIS, S. C., Phosphorescence in scintillation counting, 16: 16095
EL'MAN, A. D., Elution of Np from Am anionite, 16: 16394
ELMER, Thomas H., Scintillator, 16: 16894
EL-NESR, M. S., Decay of Lu-177 to Hf-177, 16: 17093
EL-NESR, M. S., Pure E2 transition in Hg-196, 16: 17100
EL-SAYED, M. A., Excitation migration in organic crystals, 16: 16379
ELSEA, A. R., Effects of Nb on steel, 16: 16737
ELWYN, A. J., Polarization of neutrons, 16: 17091
ELY, P. P., Selection rule $\Delta Q = \Delta S$, 16: 16953 (NP-11592(Vol.I)(p.209-15))
ENGELDER, T. C., Exponential experiments on D_2O–H_2O moderated lattices, 16: 17228 (BAW-1233)
ENGELEN, Michèle, Analysis of photographic emulsions, 16: 16362
ENGELS, J. C., Isotopic geochemistry, 16: 16577 (TID-14861(Vols.I and II))
ENGLERT, Gerhard, Broad-line NMR spectrometer, 16: 16525 (NP-11497)
ENGLISH, J. L., Brazing alloys for stainless steel fuel elements, 16: 16675 (ORNL-2834)
EPSTEIN, J. H., Applications of hypervirial theorems, 16: 16815
EPSTEIN, Melvin, Wave propagation in plasma, 16: 17199
EPSTEIN, S. T., Applications of hypervirial theorems, 16: 16815
EQUER, B., K_1^0 decay in a Wilson chamber, 16: 16954 (NP-11592(Vol.I) (p.227-34))
ERICKSON, Eugene E., Continuous treatment apparatus, 16: 16470
ERICKSON, G. P., Isotopic geochemistry, 16: 16577 (TID-14861(Vols.I and II))
ERMOLOV, P.F., Mesic atom processes in H_2, 16: 16884
ERNST, H., Cationic fluorocomplexes in rats, 16: 16167
EROFEEV, B. V., Effect of Co-60 on cobalt formate, 16: 16410 (AEC-tr-5054)
ERSHOV, A. G., Betatron and synchrotron oscillations of electrons, 16: 17171
ERWIN, A. R., Inelastic hyperon production with π^-, 16: 16977 (NP-11592 (Vol.I)(p.371-4))
ERWIN, A. R., On π-π interactions, 16: 16958 (NP-11592(Vol.I)(p.249-56))
ESKELSON, Cleamond D., Labeling pharmaceutical compounds, 16: 16443
ESTOURNEL, R., Safety apparatus for radioactive accidents, 16: 16597 (CEA-2113)
ETIENNE, M., Response of visual cortex of cat, 16: 16263
ETO, H., Whole-body counters at Japan NIRS, 16: 16143
EUBANKS, A. G., Process for applying ceramic and cermet coatings, 16: 16641 (ARL-59)
EVAN-IWANOWSKI, R. M., Prog. rpt. on stability of spherical shells, 16: 16472 (AROD-2465:1)
EVANS, D., Production of electron pairs by pions, 16: 16935 (NP-11592(Vol.I)(p.79-83))
EVANS, D. S., State of cerium in Th–Ce, 16: 16748
EVANS, Titus C., Indirect action of radiation, 16: 16230
EVERARD, A. F., Free-radical arylation induced by γ radiation, 16: 16436
EWING, R. I., Neutron background from betatron, 16: 17158 (SCR-481)

F

FABBRI, O., Selection rule $\Delta Q = \Delta S$, 16: 16953 (NP-11592(Vol.I) (p.209-15))
FABIANI, F., Annihilation in flight of positrons, 16: 16946 (NP-11592 (Vol.I)(p.151-3))
FABRICIUS, E. D., Solid state solar generator, 16: 16518 (ASD-TR-61-564)
FACCHINI, A., Evaporator for radioactive liquids, 16: 17335
FACCHINI, A., Stability in gas–graphite reactor, 16: 17302
FAIN, J., "Incorporated target" technique with nuclear emulsions, 16: 16967 (NP-11592(Vol.I)(p.307-25))
FALCHI, Q., Bronchopulmonary disease during radiotherapeutic treatment, 16: 16227
FALK-VAIRANT, P., Conference on elementary particles, Aix-en-Provence, Sept. 1961, 16: 16925 (NP-11592(Vol.I))
FALK-VAIRANT, P., Conference on elementary particles, Aix-en-Provence, Sept. 1961, 16: 16993 (NP-11592(Vol.II))
FALK-VAIRANT, P., Neutral processes in π^--p interaction, 16: 16932 (NP-11592(Vol.I)(p.45-55))
FANALE, F. P., Isotopic geochemistry, 16: 16577 (TID-14861(Vols.I and II))
FANT, W. M., Response of rabbits to nephrotoxic serum, 16: 16195
FARINI, F., Selection rule $\Delta Q = \Delta S$, 16: 16953 (NP-11592(Vol.I(p.209-15))
FARIS, B. F., Precipitation of plutonous peroxide, 16: 16468
FARMER, F. T., Supervoltage therapy. Review., 16: 16214
FARWELL, G. W., Analysis of cyclotron α particles, 16: 16542
FAY, Homer, Emission spectrometer, 16: 16570
FAZZINI, T., Antiproton-proton total cross sections, 16: 16963 (NP-11592 (Vol.I)(p.283-6))
FEDER, B. H., Radiation-conditioned behavior, 16: 16266
FERRARI, H. M., Mixed valence thermoelectric materials, 16: 16734 (WCAP-1655)
FERRERO, F., Photoneutron angular distribution, 16: 17089
FETTWEIS, P. F., Fast pneumatic transfer tube, 16: 17313
FEUVRAIS, L., Method for determining proton polarization, 16: 16965 (NP-11592(Vol.I)(p.295-9))
FIDECARO, G., Antiproton-proton total cross sections, 16: 16963 (NP-11592(Vol.I)(p.283-6))
FIDECARO, M., Annihilation in flight of positrons, 16: 16946 (NP-11592 (Vol.I)(p.151-3))
FIDECARO, M., Photon production in p-p collisions, 16: 16934 (NP-11592(Vol.I)(p.73-7))
FIELD, A. L., Jr., Working properties of Nb, 16: 16747
FIJALKOWSKI, J., Analysis of radioactive solutions, 16: 16306 (PAN-250/XIII)
FILATOVA, T. M., Plasma instability in toroidal discharge, 16: 17206
FILIPPI, C., Selection rule $\Delta Q = \Delta S$, 16: 16953 (NP-11592(Vol.I) (p.209-15))
FINDEIS, A. F., On-stream tracer techniques, 16: 16069
FINDL, E., Nitrosyl chloride solar fuel cell system, 16: 16480 (WADD-TR-60-821(Pt.II))
FINE, Joseph, Dissociation energies of Cs halides, 16: 16358
FINN, Ronald Stephen, Diffusion of plasma across magnetic field, 16: 17175 (AFCRL-1028)

FINOCCHIARO, G., Annihilation in flight of positrons, 16: 16946 (NP-11592(Vol.I)(p.151-3))
FINOCCHIARO, G., Photoproduction of π^+ mesons in H_2, 16: 16928 (NP-11592(Vol.I)(p.21-4))
FINOCCHIARO, G., Photon production in p-p collisions, 16: 16934 (NP-11592(Vol.I)(p.73-7))
FINZI, R., Photoproduction of π^+ mesons in H_2, 16: 16928 (NP-11592 (Vol.I)(p.21-4))
FIORINI, E., Momentum spectrum of slow protons, 16: 16985 (NP-11592 (Vol.I)(p.449-52))
FIREMAN, E. L., Tritium in meteorites, 16: 16080
FISHER, Delbert H., Methods and instruments for evaluation of refractory materials, 16: 16572 (ASD-TR-61-74)
FISHMAN, F., Current distribution for large radius-ratio mast, 16: 16803 (AFOSR-2194)
FLAGG, A. H., Nuclear rocket for space propulsion, 16: 17325
FLANAGAN, T. P., Measurement of film thickness, 16: 16622
FLEITMAN, A., Corrosion studies in Hg and Na systems, 16: 16677 (TID-7626(Pt.I)(p.23-34))
FLEROV, G. N., Interaction of N-14 and Ne-20 with C, Al, Cu, and Ta, 16: 17153
FLEROV, G. N., Nuclear methods in prospecting, 16: 16043
FLETCHER, E. E., Effects of Nb on steel, 16: 16737
FLETCHER, J. M., Nitratonitrosylruthenium complexes, 16: 16381
FLETCHER, Stephen Baldwin Dunwich, Self engaging couplings, 16: 16487
FOERSTER, Friedrich, Non-destructive techniques for radiation damage in pressure vessel materials, 16: 16791
FOGLIA, Sebastien, Emergency discharge of fuel elements, 16: 17254
FOLEY, K. J., Bombardment of O-16 and F-19 with protons, 16: 17088
FOLSOM, T. R., Magnetic tape for evaluation of γ spectra, 16: 16153
FORD, K. W., Nuclear data tables. IV., 16: 17154
FORRAT, F., Magnetic structure work at Grenoble, 16: 16834
FOSHEE, D. P., Indirect fetal irradiation effects, 16: 16272
FOURNET, Louis, Analysis of Zr after neutron irradiation, 16: 16784
FOX, J. G., Second postulate of special relativity, 16: 16816
FRAKER, Anna C., Nitrogen alloys of transition metals, 16: 16768
FRANCESCHINI, A., Concentration of Ar-41 in pool reactor, 16: 17312
FRANCOIS, B., Moist hydrogen as sintering atmosphere, 16: 16647 (EURAEC-194(App.4))
FRANK, G. M., Radiation reactions as disturbance of capacity of vital phenomena, 16: 16180 (JPRS-13154(p.1-8))
FRANKEL, S., Electronic relaxation in Sm^{++} in EuIG, 16: 16832
FRANKLIN, R. N., Plasma-sheath boundary, 16: 17201
FRASER, P. A., Scattering of ortho-positronium, 16: 16870
FRAZER, Jack W., Preparation of binary N_2–F_2 compounds, 16: 16402
FRAZIER, Virginia L., Defense Metals Information Center accessions, 16: 16727 (NP-11553)
FREDERICK, David Eugene, Polarization of neutrons from photodisintegration of D, 16: 16924 (NP-11509)
FREEMAN, A. J., Nuclear magnetic moments of rare-earth ions, 16: 16831
FREEMAN, G. R., Radiolysis of methylcyclohexane. I., 16: 16417
FREEMAN, G. R., Radiolysis of methylcyclohexane. II., 16: 16418
FREESTONE, R. M., Jr., Shield of Illinois Univ. Triga Mark II reactor, 16: 17310 (ORNL-TM-178)
FRENCH, B. R., Pion production by protons in hydrogen, 16: 16984 (NP-11592(Vol.I)(p.433-47))
FRETTER, W. B., Low-multiplicity jets produced by high-energy pions, 16: 16986 (NP-11592(Vol.I)(p.453-7))
FREUND, P. G. O., Scattering and reaction amplitudes in unphysical Riemann sheets, 16: 16968 (NP-11592(Vol.I)(p.327-30))
FRIGERIO, G., Uranium metal in fused UO_2, 16: 16758
FRIGERIO, Norman A., Neutron capture therapy, 16: 16215
FRISBY, Henri, Electron microscope study of BeO, 16: 16735 (AEC-tr-5028)
FRISCH, E., Coupling, 16: 16496
FRITZ, E. G., Behavior of irradiated polyurethane elastomers, 16: 16779 (NARF-62-2T)
FRITZ, James S., Separations using sulphosalicylic acid, 16: 16329
FROEMAN, Anders, Isotopic effects and electronic energy in molecules, 16: 16357
FRY, W. A., Ultra high vacuum valve, 16: 16497
FRY, W. F., Selection rule $\Delta Q = \Delta S$, 16: 16953 (NP-11592(Vol.I)(p.209-15))
FRYER, J. R., Determination of indium, 16: 16319
FRYNTA, Z., Radioisotopic control of wear, 16: 16065
FUBINI, S., Electromagnetic structure of pions and nucleons, 16: 16997 (NP-11592(Vol.II)(p.33-55))
FUCKS, W., Magnetohydrodynamic theory of lubrication, 16: 16855
FUJII, T., Inelastic p-p scattering, 16: 16983 (NP-11592(Vol.I)(p.419-25))
FUJITA, S., Two generalized master equations, 16: 16637
FUKUDA, Masasi, Chemical protection against radiation, 16: 16298
FULLER, E. G., Nuclear photoeffect in Ho and Er, 16: 17083
FULLER, Gladys H., Nuclear data tables. IV., 16: 17154
FULTZ, S. C., Positron annihilation at 15 Mev, 16: 17012
FUMAGALLI, Z., Effects of radiation on neuron substructure, 16: 16278
FURNO, A. L., Prog. rpt. on use of liquid hydrogen in bubble chambers, 16: 16610 (TID-15422)
FURUICHI, Susumu, Nucleon-nucleon scattering, 16: 17038

G

GABOR, D., Direct generation of electricity, 16: 16848
GAILLARD, J. M., Proton scattering in region 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))
GAILLARD, J. M., Reaction $\pi^- + p \rightarrow \Lambda^0 + K^0$ at threshold, 16: 16952 (NP-11592(Vol.I)(p.203-7))
GALE, H. J., Scintillation alpha spectrometry, 16: 16552
GALE, H. H., Reaction $B^{11}(\alpha,n)N^{14}$, 16: 17119
GALIL, U., Array for investigation of air showers, 16: 16514 (AFCRL-1092)
GALLAGHER, E. V., Loading on building and equipment shapes, 16: 16574 (WT-721)
GANGLOFF, H., Effects of irradiation on brain, 16: 16264
GARBELLANO, David W., Radiation detector, 16: 16568
GARBUTT, D. A., Proton-proton elastic scattering, 16: 16936 (NP-11592(Vol.I)(p.85-91))
GARCIA, J., Radiation-conditioned behavior, 16: 16266
GARDNER, L. R. T., Creep tests on alpha U, 16: 16770
GARDNER, N. R., Uranium dioxide and ceramic fuels, 16: 16660
GARDNER, Richard E., Radiation effects on solid rocket motor components, 16: 16778 (JPL-TR-32-234)
GARG, J. B., Reaction $B^{11}(\alpha,n)N^{14}$, 16: 17119
GARIOD, Roger, Demagnetizing devices, 16: 16485
GARNETT, J. L., Deuterium exchange reactions. III., 16: 16344
GARRETT, Harold J., Radiation induced overaging of Al alloy, 16: 16774 (ARL-132)
GARRISON, Warren M., Radiation-induced oxidation of protein, 16: 16439
GARRONI, A., Stability in gas–graphite reactor, 16: 17302
GARWIN, R. L., Lepton physics, 16: 16994 (NP-11592(Vol.II)(p.3-13))
GASTEIGER, E. L., Effects of uv and ionizing radiations on nerve, 16: 16256
GATES, L. D., Spectral shift control reactor physics, 16: 17286 (BAW-1230(Pt.II))
GATTI, G., Photon production in p-p collisions, 16: 16934 (NP-11592 (Vol.I)(p.73-7))
GATTO, R., Possibilities with colliding beams of electrons and positrons, 16: 16992 (NP-11592(Vol.I)(p.487-501))
GAUME-MAHN, Francoise, Attack of Mo by liquid Ce, 16: 16693
GAVALAS, G., Prog. rpt. on two-phase compressible flow, 16: 16504 (TID-15429)
GEISLER, M., Evaluation of γ scintillation spectrograms, 16: 16533
GEISS, J., Ages of iron meteorites, 16: 16040
GEL'FMAN, A. Ya., Determination of cesium, 16: 16324
GELLER, Murray, Elliptical coordinate wave functions, 16: 16845
GELLES, S. H., Interactions between core and cladding, 16: 16662
GELLES, S. H., Prog. rpt. on Be research, 16: 16725 (NMI-9517)
GELSEMA, E. S., V^0 pairs produced in propane bubble chamber, 16: 16938 (NP-11592(Vol.I)(p.101-10))
GENISSON, J., Mercury porosimeter for nuclear graphite, 16: 16521 (CEA-2093)
GENSOLLEN, C., Pion production by π^+, 16: 16930 (NP-11592 (Vol.I)(p.27-35))
GEORGE, G. G., Absolute counting of Ru-103, 16: 16421
GERDANIAN, Paul, Nonstoichiometry of U oxides, 16: 16738
GERGELY, Gy., Range of energy propagation in phosphors, 16: 16861

GERHART, J. B., Positron polarization in Fermi-type transition, 16: 16059
GERMAIN, P., Steady perfect fluid flow, 16: 16908
GEROLD, V., Zone formation in Al–Zn alloys, 16: 16766
GERSHTEIN, S. S., Mesic atom processes in H_2, 16: 16884
GERSON, N. C., Radiowave absorption in ionosphere, 16: 16916
GERVASIO, V., Stability in gas–graphite reactor, 16: 17302
GEVANTMAN, Lewis H., Measuring radiation tri-directionally, 16: 16567
GHESQUIERE, G., Antiproton-proton total cross sections, 16: 16963 (NP-11592(Vol.I)(p.283-6))
GHILARDOTTI, G., Reactivity changes in natural U graphite lattices, 16: 17244
GIACOMELLI, G., Annihilation in flight of positrons, 16: 16946 (NP-11592 (Vol.I)(p.151-3))
GIACOMELLI, G., Photon production in p-p collisions, 16: 16934 (NP-11592(Vol.I)(p.73-7))
GIBBONS, P. E., Gallium phosphide diodes, 16: 16551
GIDEON, Donald N., Methods and instruments for evaluation of refractory materials, 16: 16572 (ASD-TR-61-74)
GIEMZA, C. J., Structural response of Be sheet, 16: 16714 (ASD-TR-61-87)
GILBERT, A., Method and sand labeling, 16: 16586
GILLES, Jean-Claude, Phases from action of ammonia on zirconia, 16: 16350
GINDLER, James E., Radiochemistry of U, 16: 16405 (NAS-NS-3050)
GINTHER, Robert J., Radiation sensitive glass containing Ce, 16: 16892
GLADYSHEVSKII (GLADYSHEVSKIY), E. I. (Ye. I.), Structure of $CrBe_{12}$, VBe_{12}, and $NbBe_{12}$, 16: 16717 (DC-58-11-114)
GLANSDORFF, P., Solution of the Boltzmann equations, 16: 16852
GLASSTONE, Samuel, Energy from nuclear fission, 16: 16655
GLAUERT, M. B., Boundary layer on magnetized plate, 16: 16512
GLOOR, Max, Vapor pressure and thermal dissociation of $NbOCl_3$, 16: 16390
GNEPF, Hans, Phosphate as complexing agent for Sr, 16: 16399
GODART, Jean, Improvements in remote control devices, 16: 16466
GOEBEL, K., Radiation age of meteorites, 16: 16039
GOEL, P. S., Cosmic ray produced P-32, P-33, Be-7, and S-35, 16: 16589
GOERLICH, P., Thermoluminescence of CaF_2 crystals, 16: 16859
GOLAND, A. N., Fission fragment damage in thin films, 16: 16787
GOL'DANSKII, V. I., Mössbauer effect in tin-bearing polymer, 16: 16889
GOLDBERG, Edward D., Studies of deep sea sediments, 16: 16583
GOLDBLITH, S. A., Radiosensitivity of *Escherichia coli*, 16: 16220
GOLOVATENKO, R. T., Uranyl nitrate extraction by diethyl ether, 16: 16461
GOLUBEV, N. V., Determination of $MsTh_1$, 16: 16323
GONZALES, D., Scintillation detection of tritium, 16: 16091
GOODRICH, Max, Bremsstrahlung from P-32 and Y-90, 16: 17107
GOODYEAR, C. C., Dissociation and ionization of H, 16: 16871
GOOSEY, R., Melting and casting of Be, 16: 16651
GOR'KOV, L. P., Liquid He-3 transition to superfluid state, 16: 16888
GOTO, Hidehiro, Determination of Ta in Nb, 16: 16313
GRABOWSKY, Wallis, Prog. rpt. on energy conversion, 16: 17314 (AD-266439)
GRACE, Richard E., Prog. rpt. on oxidation of Cr, 16: 16340 (TID-15370)
GRAD, H., Collisionless shock theory, 16: 16913
GRAHAM, C. B., Superheater for boiling water reactor, 16: 17304
GRAHAM, R. P., Applications of the mercury electrode, 16: 16318
GRARD, F., Proton scattering in region 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))
GRAUDYNYA, L. Ya., Neutron inelastic scattering by Ta-181, 16: 17140
GRAY, Paul E., Behavior of thermoelectric devices, 16: 16890
GREEN, H. M., Ductility of Zy-clad fuel elements, 16: 16723 (NMI-7211)
GREEN, R. M., Excretion of Cs-137 in human, 16: 16152
GREEN, S. I. E., Bipyridyl complexes of Be, 16: 16382
GREENE, D., Exposure dose measurements, 16: 16216
GREENSPAN, J., Cladding and bonding techniques, 16: 16666
GREENWOOD, G. W., Fission gas re-solution during heat treatment, 16: 16755
GREGG, S. J., Oxidation of Magnox A12, 16: 16696
GREGORY, J. N., Radioisotope techniques in Australia, 16: 16068
GRIFFIN, John Dennis, Process for making graft copolymers, 16: 16449
GRIFFIN, L. H., Analysis of organically bound Cl, 16: 16311
GRIFFING, Virginia, Interaction of alkali metal with rare gas, 16: 16353
GRIFFITH, Peter, Heat transfer in nucleate pool boiling, 16: 16503 (NP-11491)
GRIFFITHS, G. M., Capture of protons by deuterons, 16: 17010
GRIFFITHS, Jack Jones, Improvements in pressure vessels, 16: 17250
GRIFFITHS, R. B., Properties of finite chains of exchange-coupled atoms, 16: 16802 (AFOSR-1934)
GRIGOLETTO, A., Pion production by π^+ on protons, 16: 16929 (NP-11592(Vol.I)(p.25-6))
GRILLO, Hermes C., Studies in wound healing. IV., 16: 16198
GRITSYNA, V. T., Short-period isomers Nd-140m, Pm-144m, Eu-146m, and Gd-158m, 16: 17147
GROSS, W. A., Whirl in air-lubricated journal bearings, 16: 16475 (NP-11494)
GROUNES, M., Irradiation effects in pressure vessel steel, 16: 16773 (AE-65)
GRUENWALD, Th., Dose distribution of radiation sources, 16: 16624
GRUNBERG, L., Study of reactions of metals, 16: 16054
GRUNBERG, L., Tracers in lubrication research, 16: 16063
GRUNDY, B. R., Uranium-235 content of natural U, 16: 16370
GRUPP, Erica, Effects of irradiation of mammalian embryo, 16: 16212
GRYNBERG, Marek, On the state of pion-hyperon resonance, 16: 17032
GUBAREVA, M. A., Recrystallization and phase transformations, 16: 16050
GUILL, J. H., Structure of $CrBe_{12}$, VBe_{12}, and $NbBe_{12}$, 16: 16717 (DC-58-11-114)
GUILL, James H., Thermal conductivity of refractory materials, 16: 16575 (DC-58-8-38)
GUIRALDENQ, P., Self-diffusion in gamma iron, 16: 16049
GUTHRIE, G. L., Prog. rpt. on high-temperature semiconductors, 16: 16799 (AD-265462)
GUYON, J. C., Determination of niobium, 16: 16315

H

HABERER, K., Measurement of radioactivity in water, 16: 16613
HACKE, J., Schooling in nuclear engineering. III., 16: 17011
HADANCOURT, Alain Camille, Improvements in ionization chambers, 16: 17216
HAEMMERLING, Joachim, Alteration of morphological processes by uv radiation, 16: 16239
HAENSCH, H. J., Electroluminescence of CdS single crystals, 16: 16858
HAGEDORN, R., Reabsorption of fast secondaries in nuclei, 16: 17123
HAGEN, Ulrich, Biological radiation protection. XLV., 16: 16299
HAGEN, Ulrich, Thymus atrophy after irradiation. III., 16: 16233
HAGOPIAN, N., Timing and firing for project Gnome, 16: 16029 (PNE-115P)
HAKANSSON, C. H., Irradiation of brain tumors, 16: 16260
HAKEEM, M. A., Bremsstrahlung from P-32 and Y-90, 16: 17107
HALBWACHS, F., New isobaric spin group, 16: 16990 (NP-11592(Vol.I) (p.503-6))
HALEY, F. A., Effects of radiation on mix bis ether, 16: 16780 (NARF-62-3T)
HALEY, T. J., Changes induced in brain activity, 16: 16268
HALLER, J., Isotopic geochemistry, 16: 16577 (TID-14861(Vols.I and II))
HALLOWES, K. H., Phosphorescence in scintillation counting, 16: 16095
HALVORSEN, K., Tritium in biological materials, 16: 16098
HAMER, A. N., Uranium-235 content of natural U, 16: 16370
HAMERMESH, Morton, Group theory and application, 16: 16639
HAMILTON, J., Low energy p-n scattering and p-p interactions, 16: 16973 (NP-11592(Vol.I)(p.351-4))
HAMILTON, Robert H., Preparation of labeled compounds for counting, 16: 16412
HAMMOND, Gordon L., Emission spectra of hot dense gases, 16: 16819
HAN, Chi-Yeh, Heat transfer in nucleate pool boiling, 16: 16503 (NP-11491)
HAN, L. K. R., Two connected nuclear transformations, 16: 17062 (AROD-2543:6)
HANAUER, S. H., Nuclear orientation experiments, 16: 16061
HAND, R. Marvin, Brain tumor localization by Hg-203, 16: 16231
HANNA, S. S., Absorption of gamma radiation, 16: 16060
HANNEMAN, R. E., Kossel line studies of irradiated Ni crystals, 16: 16786
HANSEN, G. J., Monitoring vibrations from Gnome, 16: 16576 (PNE-129F)

HANSEN, N. E., Positron annihilation at 15 Mev, 16: 17012
HARBOTTLE, G., Szilard-Chalmers reaction in potassium permanganate, 16: 16423
HARDGROVE, B. J., Astronautics information, Vol. 3, No. 3, 16: 17317 (NP-11476)
HARLEN, Frank, Precipitation chambers, 16: 16566
HARNED, Herbert S., Salts in organic solvent–water mixtures, 16: 16375
HARPER, John, Fuel elements for reactors, 16: 17265
HARRISON, Donald, Improvements in ionization chamber circuits, 16: 16563
HARRISON, J. D. L., Sintering behavior in PuO_2–UO_2 system, 16: 16753
HARTING, D., Annihilation in flight of positrons, 16: 16946 (NP-11592 (Vol.I)(p.151-3))
HARTING, D., Decay rate of negative muons, 16: 16944 (NP-11592 (Vol.I)(p.143-5))
HARVEY, Don A., Composite scintillation crystal, 16: 16893
HASAN, J., Determination of tritium, 16: 16102
HASEGAWA, H., Heavy primary cosmic rays, 16: 16918
HASIGUTI, Ryukiti R., Annealing stages of irradiated Cu, 16: 16794
HASL, G., Measurement of environmental radiation, 16: 16614
HASSON, R., Corrosion by UF_6. II., 16: 16695
HASTE, G. R., Plasma potential measurements, 16: 17187
HASTED, J. B., Charge transfer collisions, 16: 16868
HATCHER, C. R., Positron annihilation at 15 Mev, 16: 17012
HAUTECLER, Serge, Spectroscopy of Fe(II) in $FeCl_2$, 16: 16824
HAVLENA, Joan, Effects of prenatal radiation on rat, 16: 16221
HAWKINS, Myron B., Local fallout deposition patterns, 16: 16596 (CDRP-182-101)
HAYES, W. D., Jr., Process for applying ceramic and cermet coatings, 16: 16641 (ARL-59)
HAYMAKER, W., Changes in nervous system following radiation, 16: 16277
HAYMAKER, W., Glycogen in rat brain after irradiation, 16: 16275
HAYMAKER, Webb, Disruption of nervous tissue by radiation, 16: 16243
HAYWARD, Evans, Nuclear photoeffect in Ho and Er, 16: 17083
HEATH, D. F., Cl^{36}-dieldrin in mice, 16: 16114
HEDGER, H. J., Compound in the U–Fe–C system, 16: 16757
HEFFERNAN, J., Technical photography of surface motion, 16: 16528 (VUP-2202)
HEIM, Harold C., Biomedical effects of EM radiation. II., 16: 16174 (ASD-TR-61-195)
HEISENBERG, W., Theory of strange particles, 16: 16947 (NP-11592 (Vol.I)(p.163-8))
HEISTRACHER, P., Effects of irradiation on Purkinje fibers, 16: 16279
HENDRIE, D. L., Analysis of cyclotron α particles, 16: 16542
HENMO, E., Irradiation of unsaturated sultones, 16: 16437
HENNESSY, J., β decay of Λ^0 and Σ hyperons, 16: 16951 (NP-11592 (Vol.I)(p.197-200))
HENSHAW, Paul S., Radiologic life shortening, senescence, and carcinogenesis, 16: 16228
HERMAN, Robert, Form factors of neutron and structure of nucleons, 16: 16941 (NP-11592(Vol.I)(p.121-37))
HERNADI, F., Toxic effects of x-ray on *E. coli*, 16: 16297
HERR, W., Age of iron meteorites, 16: 16040
HERRON, David P., Fuel-element economics, 16: 16672
HERZ, A. J., Momentum spectrum of slow protons, 16: 16985 (NP-11592 (Vol.I)(p.449-52))
HEUGHEBAERT, J., Pion production by π^+, 16: 16930 (NP-11592 (Vol.I)(p.27-35))
HEUGHEBAERT, J., Proton scattering in region 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))
HEUSS, K., Radiation response of white mice, 16: 16285
HEUZEL, M., Transport of solids in watercourses, 16: 16070
HEWITT, John E., Biological effects of cosmic radiation, 16: 16192
HEYSSEL, Robert M., Whole-body-counter data processing, 16: 16154
HIEN, N. C., Inelastic p-p scattering, 16: 16983 (NP-11592(Vol.I) (p.419-25))
HILBERT, D., Methods of mathematical physics. II., 16: 16640
HILL, M. R. H., Radiolysis of liquid cyclohexane, 16: 16431
HILL, N. A., Bend properties in Be sheet, 16: 16751
HILL, Ruth F., Radioresistant mutants of *E. coli*, 16: 16206
HILLIARD, R. K., Release of radiostrontium from strontium carbonate, 16: 16336 (HW-69692)
HILLION, P., New isobaric spin group, 16: 16990 (NP-11592(Vol.I) (p.503-6))
HIMMELBLAU, D. M., Diffusion coefficients of gases, 16: 16351
HINCKS, E. P., Capture rate for muons in He, 16: 16943 (NP-11592 (Vol.I)(p.141))
HINDS, S., Energy levels of F-21 and Na-25, 16: 17092
HINE, Gerald J., Clinical body counter for long-term Na studies, 16: 16156
HINES, Roger Arnold, Process for modifying polymers, 16: 16446
HIRAKI, Hiromichi, Strangeness violating weak interactions, 16: 17048
HIRAMOTO, T., Whole-body counters at Japan NIRS, 16: 16143
HIRT, B., Ages of iron meteorites, 16: 16040
HOANG, T. F., Low-multiplicity jets produced by high-energy pions, 16: 16986 (NP-11592(Vol.I)(p.453-7))
HOBBS, W. E., Method of preparing UF_6, 16: 16403
HOBITZ, H., Radiation response of white mice, 16: 16285
HOCKINGS, E. F., Prog. rpt. on thermoelectric materials, 16: 16708 (AD-266128)
HODGE, E. S., Gas pressure bonding, 16: 16701
HODGSON, Albert G., Joule cycle for space power, 16: 17322
HOESTRA, A., Water flow in oil field, 16: 16074
HOFFMANN, L., Bending high-energy particles in nuclear emulsions, 16: 16966 (NP-11592(Vol.I)(p.301-5))
HOFFMEISTER, W., Ages of iron meteorites, 16: 16040
HOFMANN, P. L., Training program in reactor engineering, 16: 17246
HOFSTADTER, R., Form factors of neutron and structure of nucleons, 16: 16941 (NP-11592(Vol.I)(p.121-37))
HOHLER, G., π-N forward scattering, 16: 16991 (NP-11592(Vol.I)(p.485-6))
HOLDEN, Frank C., Methods and instruments for evaluation of refractory materials, 16: 16572 (ASD-TR-61-74)
HOLIK, Andrew S., Preparing various graphites for examination, 16: 16761
HOLL, R. J., Superheater for boiling water reactor, 16: 17304
HOLLANDER, J. M., Decay of Hf-173, 16: 17110
HOLLANDER, J. M., Energy levels of Lu-172, 16: 17111
HOLLANDER, J. M., Isomeric state in Y-86, 16: 17115
HOLLISTER, William L., Shielding bibliography, 16: 17222 (NP-11466)
HOLROYD, Richard A., Radiolysis of liquid cyclopentane, 16: 16424
HOLTZ, F. C., Prog. rpt. on vanadium alloys, 16: 16712 (ARF-2231-3)
HOLTZ, F. C., Prog. rpt. on Zr alloys, 16: 16674 (ARF-2198-24)
HOLZER, A., Photomultiplier tubes and scintillation apparatus, 16: 16531 (UCRL-Trans-786(L))
HOOD, Harrison P., Scintillator, 16: 16894
HOOD, R. R., Prog. rpt. on heavy water reactors, 16: 17290 (DP-715)
HOOK, Rollie E., Radiation induced overaging of Al alloy, 16: 16774 (ARL-132)
HOOPER, Frank F., Prog. rpt. on productivity in stream ecosystems, 16: 16172 (TID-15385)
HOPKINS, J. C., Positron polarization in Fermi-type transition, 16: 16059
HOPKINS, T. L., Research on metabolism of insects, 16: 16116
HOPPE, M. G., Astronautics information, Vol. 3, No. 3, 16: 17318 (NP-11493)
HOREN, D. J., Decay of Hf-173, 16: 17110
HOREN, D. J., Energy levels of Lu-172, 16: 17111
HOREN, D. J., Isomeric state in Y-86, 16: 17115
HORI, Shoichi, Relativistic strong coupling theory, 16: 17013
HORN, R. C., Prog. rpt. on energy conversion, 16: 16800 (AD-266440)
HORNE, T., Radiation sources for insect control, 16: 16126
HORSFIELD, A., Spin resonance spectrum of $CH_3CH(CO_2H)$, 16: 16429
HORSTMANN, H., Portable neutron source, 16: 16483
HOSLER, E. R., Film boiling on a horizontal plate, 16: 16508
HOSSAIN, A., Production of electron pairs by pions, 16: 16935 (NP-11592(Vol.I)(p.79-83))
HOURS, R., Studying wear of refractory linings, 16: 16066
HOURS, R. M., Scintillation counting of tritium, 16: 16094
HOUSE, Lewis L., Equilibrium in chromospheric Mg I, Ca I, and O I, 16: 16898
HOUTERMANS, F. G., Ages of iron meteorites, 16: 16040
HOWES, J. E., Jr., Wear in large diesel engines, 16: 16062
HUET, Andre, Controlling the activity of a reactor, 16: 17252
HUET, Andre, Improvements in nuclear reactors, 16: 17256
HUG, O., Action mechanisms of radiation on nervous system, 16: 16288

HUGHES, D., Plastic scintillator whole-body counter, 16: 16137
HUGHES, T. P., Plasma electron temperature, 16: 17191
HUKKOO, R. K., Whole-body counter at Trombay, 16: 16145
HULSTON, J. R., Mass spectrometer measurements. I., 16: 16581
HULSTON, J. R., Mass spectrometer measurements. II., 16: 16582
HUMPHREY, R. M., Radiosensitivity of mouse fibroblasts, 16: 16224
HUMPHREYS, K. C., Neutron measurements in void tank of Triga Mark F reactor, 16: 17311 (SCR-480)
HUQUE, H., Radiophosphorus in grasshoppers, 16: 16119
HUTCHINSON, Franklin, Effects of accelerated heavy ions, 16: 16189
HUZITA, H., Selection rule $\Delta Q = \Delta S$, 16: 16953 (NP-11592(Vol.I) (p.209-15))
HYAMS, B. D., Scattering of μ mesons on electrons, 16: 16945 (NP-11592 (Vol.I)(p.147-50))

I

ICHIMIYA, Toree, Preparation of high-purity silicon, 16: 16075
IDA, Noble N., Nuclear fuel elements, 16: 17276
IGNATKOV, V. D., Diffusion in germanium, 16: 16057
IINUMA, T. A., Plastic scintillator whole-body counter, 16: 16137
ILLES, Ferenc, Beta-ray band spectrograph. I., 16: 16536
ILLES, Ferenc, Beta-ray band spectrograph. II., 16: 16537
ILLES, Ferenc, Beta-ray band spectrograph. III., 16: 16538
IL'MENKOVA, L. I., Adsorptive properties of Pa, 16: 16388
IMRE, K., Oscillations in a relativistic plasma, 16: 17196
INGENITO, F. L., Removal cross sections of C and O_2, 16: 17064 (CNLM-3244)
INGHAM, H. S., Flame sprayed protective coatings, 16: 16703
INGRAM, David John, Fuel handling mechanisms, 16: 17274
ISHIDA, Shin, Pion-pion interaction, 16: 17037
ISSEROW, S., Ductility of Zy-clad fuel elements, 16: 16723 (NMI-7211)
ISSEROW, Saul, Fluid-fuel systems, 16: 16671
ISSEROW, Saul, Processing irradiated fuel elements, 16: 16670
IVANOVA, L. M., Determination of radioactivity in water, 16: 16325

J

JACKSON, Clive, Improvements in laboratory centrifuges, 16: 16486
JACKSON, J. D., Final state enhancement factors, 16: 17027
JACOB, Gerhard, Quasi-free electron-proton scattering. I., 16: 17094
JACOB, Gerhard, Quasi-free electron-proton scattering. II., 16: 17095
JACOB, M., On π-π interaction phase shifts, 16: 16969 (NP-11592 (Vol.I)(p.331-5))
JACOBSON, Jerry Hart, Physiological changes of eye to x radiation, 16: 16175 (ASD-TR-61-415)
JACQUES, R., Control of concentration in gaseous diffusion plant, 16: 16626 (CEA-2010)
JACQUET, Michel, Reactivity of graphite with respect CO_2 and air, 16: 16331 (CEA-1934)
JACROT, Bernard, Spectroscopy of Fe(II) in $FeCl_2$, 16: 16824
JAFFRY, P., Transport of solids in watercourses, 16: 16070
JAGGER, Paul I., Clinical body counter for long-term Na studies, 16: 16156
JAGGI, R. K., Wave motion in plasma, 16: 17200
JAHN, P., Coil arrangement for β spectrometer, 16: 16550
JAIN, B. D., Determination of zirconium, 16: 16322
JAIN, B. D., Uranium(VI)-3-acetyl-4-hydroxycoumarin complex, 16: 16368
JAIN, D. C., Excited states of LiH and RbH molecules, 16: 16872
JAIN, D. C., Potential energy curves of Li^7H^2, 16: 16821
JAMES, Allen P., Radiation-induced extrachromosomal mutation, 16: 16222
JAMES, Lawrence R., Labeling pharmaceutical compounds, 16: 16443
JAMES, W. T., Radiation effects on behavior, 16: 16265
JAMMET, H., Uses of γ spectrometer for body radioactivity, 16: 16150
JAYKO, Michael E., Radiation-induced oxidation of protein, 16: 16439
JEANMAIRE, L., Uses of γ spectrometer for body radioactivity, 16: 16150
JEFFAY, Henry, Determination of radioactive Ca, 16: 16316
JEFFRIES, D. J., Radiation effects on fertility of *Sitophilus granarius*, 16: 16125
JELLEY, J. V., Cherenkov radiation, 16: 17077
JENEY, A., Toxic effects of x-ray on *E. coli*, 16: 16297
JENKINS, D. W., Radioisotopes in studies of insects, 16: 16109
JEPSON, W. B., Oxidation of Magnox A12, 16: 16696
JOBES, M., Pion production by protons in hydrogen, 16: 16984 (NP-11592 (Vol.I)(p.433-47))
JOHNSON, C. G., Coupling, 16: 16496
JOHNSON, C. S., Capture rate for muons in He, 16: 16943 (NP-11592 (Vol.I)(p.141))
JOHNSON, Everett R., Decomposition of inorganic nitrates, 16: 16425
JOHNSON, Gordon F., Labeling pharmaceutical compounds, 16: 16443
JOHNSON, Kenneth, Canonical commutation relations, 16: 17017
JOHNSON, P. M., Behavior of irradiated polyurethane elastomers, 16: 16779 (NARF-62-2T)
JOHNSTON, J. H., Fuel subassembly concepts, 16: 16667
JOHNSTON, Joseph M., Evaluation of military radiac equipment, 16: 16530 (WT-755)
JOHNSTON, W. H., On-stream tracer techniques, 16: 16069
JONES, B. D., Hyperfragments from interactions of K^- mesons with emulsion nuclei, 16: 16976 (NP-11592(Vol.I)(p.363-9))
JONES, Eric D., NQR of As-75 in $Na_2HAsO_4 \cdot 7H_2O$, 16: 16360
JONES, Eric D., Nuclear magnetic resonance of As and Sb, 16: 16361
JONES, H. A., Radiation induced reaction between CO_2 and graphite, 16: 16408 (NPCC/MWP(G)/P161)
JONGEJANS, B., Elastic scattering and absorption of π^- on emulsion nuclei, 16: 16964 (NP-11592(Vol.I)(p.291-4))
JORDAN, H. L., High-temperature plasmas by magnetic compression, 16: 17177 (JUL-36-PP)
JOUIN, Jacques, Improvements in remote control devices, 16: 16466
JOUY, Alain D., Analysis of photographic emulsions, 16: 16362
JURKIEWICZ, J., Potassium salts prospecting, 16: 16044

K

KAFTANOV, V. S., Decay $\mu \to e + \gamma$, 16: 17056
KAGAN, M. S., Influence of radon water on gastric function, 16: 16209
KAHANA, Sidney, Forces in finite nuclei, 16: 17106
KAINOVA, A. S., Nitrogen metabolism in radiation sickness, 16: 16294
KAISER, H. J., Peripheral interactions of fast particles, 16: 17016
KAKITA, Yachiyo, Determination of Ta in Nb, 16: 16313
KALINCHENKO, B. S., Elution of Np from Am anionite, 16: 16394
KALK, W. A., Plenum to reflector block seal for HTGR, 16: 17294 (GAMD-1375)
KALLMANN, Silve, Determination of niobium, 16: 16312
KALMYKOV, L. Z., Determination of cesium, 16: 16324
KALOS, M. H., Neutron radiative absorption cross section, 16: 17070 (NDA-2093-7)
KAMATH, P. R., Handling hazards of natural Th, 16: 16593 (AEET/HP/SM-5)
KAMATH, P. R., Radiation hazards in uranium mines, 16: 16592 (AEET/HP/SM-4)
KAMMERER, O. F., Fission fragment damage in thin films, 16: 16787
KANE, G. L., Final state enhancement factors, 16: 17027
KANER, E. A., Theory of transition radiation, 16: 17207
KANG, Mei-Hsa, Concentration of actinite, 16: 16397
KANO, Y., Correlations in electromagnetic fields, 16: 16851
KANWAL, R. P., Dynamical similarity and intrinsic relations in MHD, 16: 17174 (AD-266636)
KAPLAN, Harvey, Lattice vibrations of zincblende structure crystals, 16: 16804 (AFOSR-2300)
KAPLAN, S. J., Effects of prenatal x irradiation, 16: 16271
KAPRIELIAN, Z. A., Plasma negative resistance amplifier, 16: 17189
KARCHEVSKII, A. I., Magnetic properties of β UH_3 and UD_3, 16: 16769
KARLSON, Erik T., Motion of charged particles, 16: 17197
KARPLUS, R., Scattering and reaction amplitudes in unphysical Riemann sheets, 16: 16968 (NP-11592(Vol.I)(p.327-30))
KARRAS, H., Thermoluminescence of CaF_2 crystals, 16: 16859
KARRAS, Hans, Models of absorption bands of SrF_2, 16: 16857
KASCHLUHN, F., Current operators in S-matrix theories, 16: 17022
KASHA, H., Array for investigation of air showers, 16: 16514 (AFCRL-1092)
KASTLER, D., Cayley octonions and strong interactions, 16: 16948 (NP-11592(Vol.I)(p.169-70))
KATZ, Kurt, Thermoelectric generators, 16: 16826
KAUFMAN, A. M., Nuclear data tables. IV., 16: 17154

KAUFMAN, Joyce J., Ionization potentials of free radicals and molecules, 16: 16406 (NP-11495)

KAUFMAN, W. J., Canal seepage measurements with T, 16: 16082

KAUFMAN, W. J., Scintillation counting of tritium, 16: 16094

KAUFMANN, Albert R., Fuel-element problems, 16: 16656

KAUFMANN, Albert R., Nuclear reactor fuel elements, 16: 16654

KAWAI, Mitsuji, Semi-classical model for nuclear reactions, 16: 17131

KAYE, Brian Howard, Improvements in centrifuges, 16: 16491

KAZANTSEV, E. I., Elution of Np from Am anionite, 16: 16394

KAZARNOVSKII, M. V., Theory of resonance scattering, 16: 16886

KAZARYAN, A. D., Healing of infected wounds from radiation, 16: 16211

KECK, J. C., Current distribution for large radius-ratio mast, 16: 16803 (AFOSR-2194)

KEEFE, D., K^+-nucleon total and differential cross-sections, 16: 16957 (NP-11592(Vol.I)(p.247))

KEEN, N., Radicals in irradiated formates and oxalates, 16: 16435

KELLNER, G., Elastic scattering of protons on H_2, 16: 16939 (NP-11592(Vol.I)(p.111-15))

KELSCH, J. J., Fission fragment damage in thin films, 16: 16787

KEMP, R. F., Plasma potential probe, 16: 17203

KENNA, B. T., Isolation of naturally occurring Tc, 16: 16369

KENNEDY, J., Partial wave amplitudes for ingoing and outgoing particles, 16: 16970 (NP-11592(Vol.I)(p.337-42))

KENNEL, R. P., Two connected nuclear transformations, 16: 17062 (AROD-2543:6)

KEREN, J., Reaction $\pi^- + p \to \Lambda^0 + K^0$ at threshold, 16: 16952 (NP-11592 (Vol.I)(p.203-7))

KERN, E., Fuel element charging of reactors, 16: 17243

KERTH, L., K^+-nucleon total and differential cross-sections, 16: 16957 (NP-11592(Vol.I)(p.247))

KESSLER, D., Hyperon-pion resonances, 16: 16980 (NP-11592(Vol.I) (p.389-94))

KESSLER, P., Quasi-real processes in high-energy physics, 16: 16950 (NP-11592(Vol.I)(p.191-5))

KHABIBULLINA, E. M., Proton-proton elastic scattering at 2.8 Bev, 16: 17050

KHALKIN, V. A., Concentration of actinite, 16: 16397

KHAN, M. Aslam, AlD band at 2187 Å, 16: 16383

KHODADAD, Parviz, Neutral tellurite of tetravalent U, 16: 16349

KHOL (KKHOL), F., Radioisotopic control of wear, 16: 16065

KHOMENKO, L. A., Diffusion in germanium, 16: 16057

KHURTINA, E. V., Influence of radon water on gastric function, 16: 16209

KIEFER, H., Determination of Pu-239 body burden, 16: 16148

KIENLE, P., Mössbauer effect in Sn-119, 16: 17138

KIENLE, P., 84-Kev level in Yb-170, 16: 17135

KIESSLING, D., Radiation effects on polyvinyl chloride, 16: 16428

KIKINDAI, Tivadar, Exchange properties of Zr phosphate, 16: 16347

KILLICK, R. A., Determination of Ru in Pt, 16: 16326

KILP, G. R., Mixed valence thermoelectric materials, 16: 16734 (WCAP-1655)

KIM, Y. E., Isomeric state in Y-86, 16: 17115

KING, N. M., Errors in A/G proton linear accelerator, 16: 17156 (AERE-T/M-126)

KINSON, J., Pion production by protons in hydrogen, 16: 16984 (NP-11592 (Vol.I)(p.433-47))

KIPFER, P., Air radioactivity in the Antarctic, 16: 16042

KIRCHNER, Henry P., Prog. rpt. on thermal expansion of ceramics, 16: 16715 (CAL-PI-1273-M-10)

KIRILLOVA, L. F., Proton-proton elastic scattering at 2.8 Bev, 16: 17050

KIRK, David A., Working fluids program, 16: 16685 (TID-7626 (Pt.I)(p.111-14))

KIRTCHIK, H., Analysis of oxygen in alkali metal, 16: 16687 (TID-7626(Pt.I)(p.130-40))

KISHKIN, S. T., Recrystallization and phase transformations, 16: 16050

KISS, Julius, Pathogenesis of late radiation injury, 16: 16301

KISTNER, G., Measurement of Y-90-oxalate deposits, 16: 16427

KJELLBERG, Raymond N., Proton beam for intracerebral lesions, 16: 16248

KJELLGREN, O., Principles of centrifuge separation, 16: 16458

KLABUNDE, C. E., Resistivity of sodium, 16: 16789

KLAMUT, C., Corrosion studies in Hg and Na systems, 16: 16677 (TID-7626(Pt.I)(p.23-34))

KLATZO, I., Glycogen in rat brain after irradiation, 16: 16275

KLECKER, R. W., Superheater for boiling water reactor, 16: 17304

KLEIN, J. L., Uranium and its alloys, 16: 16657

KLEINECKE, David C., Local fallout deposition patterns, 16: 16596 (CDRP-182-101)

KLEINSTEUBER, A. T., Preparation of Th oxide particles, 16: 16404

KLOFT, W., Excretion of labeled phosphate in aphids, 16: 16122

KLOFT, W., Radioisotope measurement in insect metabolism, 16: 16120

KLYARFELD, B. N., Ignition of gas discharge in H_2, 16: 16883

KLYUCHAREV, A. P., Short-period isomers Nd-140m, Pm-144m, Eu-146m, and Gd-158m, 16: 17147

KNAPP, F. W., Radiosensitivities of fat-soluble vitamins, 16: 16623

KNEIP, T. J., Sample bottles and bottle-sealing methods, 16: 16474 (MCW-1455)

KNIGHT, B., The Szilard-Chalmers reaction in bromoethane, 16: 16422

KNIGHT, R. A., Melting and casting of Be, 16: 16651

KNIGHTS, Herbert Chilvers, Improvements in reactors, 16: 17267

KNOP, G., Scattering of μ mesons on electrons, 16: 16945 (NP-11592 (Vol.I)(p.147-50))

KOCH, L., Isotopic geochemistry, 16: 16577 (TID-14861(Vols.I and II))

KOCH, Siegfried, Radiation sources in engineering, 16: 16625

KOCH, W., Elastic scattering of protons on H_2, 16: 16939 (NP-11592 (Vol.I)(p.111-15))

KOCHER, C. W., Hyperfine fields in Fe_2Ti and Fe_2Zr, 16: 16833

KOEHLER, W. C., Magnetic ordering in thulium, 16: 16835

KOEHLER, W. C., Neutron diffraction of Pd and Fe group alloys, 16: 16839

KOEHNLEIN, W., Radiation-produced radicals, 16: 16434

KOENIG, L. A., New relative nuclidic masses, 16: 17086

KOENIG, L. A., 1961 nuclidic mass table, 16: 17087

KOETHE, A., Thermoluminescence of CaF_2 crystals, 16: 16859

KOFSTAD, P., Metallic oxide phases of Nb. II., 16: 16745

KOGA, Toyoki, Rarefaction of plasmas, 16: 17180 (USCEC-83-212)

KOIDE, Minoru, Studies of deep sea sediments, 16: 16583

KOLAR, Jaromir, Radiation cancer after hemangioma treatment, 16: 16236

KOLOGRIVOV, R., Isotopic geochemistry, 16: 16577 (TID-14861(Vols.I and II))

KONDRATOV, P. I., Elution of Np from Am anionite, 16: 16394

KONSTANTINOV, B. P., Proton energy and angular distributions from $Ca^{40}(\gamma,p)K^{39}$, 16: 17139

KONSTANTINOVIC, Jovan, Spectroscopy of Fe(II) in $FeCl_2$, 16: 16824

KONUMA, Michiji, Gauge transformation for meson fields, 16: 17018

KOPALEISHVILI, T. I., Photonuclear reaction $He^4(\gamma,np)D$, 16: 17149

KOPANETS, E. G., Resonances in $Si^{30}(p,\gamma)P^{31}$ reaction, 16: 17145

KOPECKY (KOPETSKII), V., Radioisotopic control of wear, 16: 16065

KORNBICHLER, H., Stability of boiling water reactors, 16: 17242 (AEC-tr-4995)

KOSENKO, V. E., Diffusion in germanium, 16: 16057

KOSTOCHKIN, O. I., Neutron inelastic scattering by Ta-181, 16: 17140

KOSYAKOV, K. S., Excretion of desoxycytidine in radiation sickness, 16: 16293

KOSYI, A. I., Plasma instability in toroidal discharge, 16: 17206

KOTANI, Tsuneyuki, Resonance in pion production process, 16: 17036

KOUNOSU, S., Nanosecond coincidence circuit, 16: 16557

KOVACEVICH, E. A., Potassium corrosion studies, 16: 16679 (TID-7626(Pt.I)(p.63-8))

KOVACS, A., Three-pion resonances in π^+-D reactions, 16: 16962 (NP-11592(Vol.I)(p.277-82))

KOVALEVA, T. V., Uranyl nitrate extraction by diethyl ether, 16: 16462

KOVNER, M. S., Cherenkov instability in non-equilibrium magnetoactive plasma, 16: 17185 (JPRS-12990(p.367-71))

KOWALSKI, E., Isolation and purification of glycoprotein fraction, 16: 16104 (PAN-252/X)

KRAEMER, R., Three-pion resonances in π^+-D reactions, 16: 16962 (NP-11592(Vol.I)(p.277-82))

KRAL, Zdenek, Radiation cancer after hemangioma treatment, 16: 16236

KRASNER, S., Form factors of neutron and structure of nucleons, 16: 16941 (NP-11592(Vol.I)(p.121-37))

KRASNOPEVTSEV, V. V., Irradiation of dielectrics in reactors, 16: 16785

KRASNYKH, I. G., Radioprotective effect in combined preparations, 16: 16296

KRAUPP, O., Effects of irradiation on Purkinje fibers, 16: 16279

KRAUSHAAR, Jack J., Biomedical effects of EM radiation. II., 16: 16174

(ASD-TR-61-195)
KRIPYAKEVICH, P. I., Structure of CrBe$_{12}$, VBe$_{12}$, and NbBe$_{12}$, 16: 16717 (DC-58-11-114)
KRISE, George M., Irradiation dose estimation, 16: 16238
KROHN, David L., Physiological changes of eye to x radiation, 16: 16175 (ASD-TR-61-415)
KRONE, R. W., Gammas from proton capture of Mg-25, 16: 17103
KRUDTAA, O. J., Metallic oxide phases of Nb. II., 16: 16745
KRUMHANSL, J. A., Studies of crystal imperfections, 16: 16058
KRUPKA, Milton C., Vaporization behavior and properties of HfB$_2$, 16: 16722 (LA-2611)
KRZUK, J., Potassium salts prospecting, 16: 16044
KUBOTA, Y., Magnetic characteristics of hydrogenated Ho, 16: 16840
KUEHNE, K., Thermoluminescence of CaF$_2$ crystals, 16: 16859
KUENDIG, Walter, Nuclear magnetic moment of Dy-160 and Er-166, 16: 17155
KUHLMAN, Carl W., Prog. rpt. on UO$_2$ powders, 16: 16730 (ORO-543)
KUHLMANN-WILSDORF, D., Dislocation behavior in irradiated stainless steel, 16: 16790
KULIK, I. O., Collective energy losses in anisotropic plasma, 16: 17208
KULP, J. Laurence, Isotopic geochemistry, 16: 16577 (TID-14861(Vols.I and II))
KUNEN, A. E., Prog. rpt. on thermionic power generator, 16: 16810 (PPL-TR-61-22)
KUNEN, Alfred E., Electromagnetic pinch effect for propulsion, 16: 17320 (PPL-116)
KUNZLER, J. E., Superconducting materials, 16: 16830
KUPPERMANN, Aron, Diffusion kinetics in radiation chemistry. II., 16: 16416
KURNICK, S. W., Prog. rpt. on high-temperature semiconductors, 16: 16799 (AD-265462)
KURODA, P. K., Isolation of naturally occurring Tc, 16: 16369
KURZ, R., Instruments for proportional counter tubes, 16: 16535
KUSHNIRENKO, E. A., Mesic atom processes in H$_2$, 16: 16884
KUSTOV, V. V., Formation of CO in radiation sickness, 16: 16292
KUTUZOV, A. A., Protective properties of water, polyethylene, and Plexiglas, 16: 17059
KUYPER, E., Water flow in oil field, 16: 16074
KUZNETS, E. I., Radioprotective effect in combined preparations, 16: 16296
KVITEK, L. C., Multigroup calculations of neutron kinetics, 16: 16632 (ANL-6511)
KWIECINSKI, J., Theory of (γ,d) reactions, 16: 17071 (NP-11564)

L

LACOMBE, P., Self-diffusion in gamma iron, 16: 16049
LADU, M., Control of radiation surrounding the synchrotron, 16: 17163
LAGEMANN, Robert T., Whole-body-counter data processing, 16: 16154
LAGNAUX, J. P., Hyperfragments from interactions of K$^-$ mesons with emulsion nuclei, 16: 16976 (NP-11592(Vol.I)(p.363-9))
LAGNAUX, J. P., Interactions of K$^-$ mesons in emulsion, 16: 16975 (NP-11592(Vol.I)(p.359-61))
LAL, D., General circulation in the atmosphere, 16: 16585
LAL, Siddheshwar, Interactions at 150 Bev in C, 16: 17114
LALOS, George T., Emission spectra of hot dense gases, 16: 16819
LAMBETH, Dennis Ernest, Precipitation chambers, 16: 16566
LAMM, Alphonse, Vulcanization of elastomers by radiation, 16: 16413
LAND, C. C., Plutonium–Al phase diagram, 16: 16750
LAND, G. A., Isotopic abundance measurements, 16: 16317
LANDSBERG, L. G., Decay $\mu \to e + \gamma$, 16: 17056
LANE, R. O., Polarization of neutrons, 16: 17091
LANGENDORFF, Hanns, Biological radiation protection. XLV., 16: 16299
LANGER, S., Prog. rpt. on carbide cathode studies, 16: 16807 (GA-3093)
LANGHOFF, J., Ages of iron meteorites, 16: 16040
LANSIART, A., Results with CEA γ spectrograph, 16: 16141
LARDNER, R. W., Analyticity of the general unitarity term, 16: 17019
LARNER, Y., Krypton purification, 16: 16455 (CEA-2111)
LARSON, E. A., Capture of protons by deuterons, 16: 17010
LASER, H., Irradiation effects in yeast, 16: 16223
LAUGHLIN, John S., Absorbed dose in water, 16: 16555
LAUGIER, Jean, Ordered Fe–Ni structure from neutron irradiation, 16: 16782
LAURENT, Henri, Improvements in remote control devices, 16: 16466
LAVERGREN, B. T., De-excitation of doublet in Al-27, 16: 17129
LAWLER, James H. L., Para-ortho shift in H$_2$–N$_2$ heat exchange, 16: 16506 (WADD-TN-60-238)
LAWROSKI, Stephen, Reactor Fuel Processing, Vol. 4, No. 3, 16: 16464
LAX, Benjamin, High magnetic field research, 16: 16828
LAZARUS, D., Intermetallic diffusion, 16: 16047
LAZZARINI, E., Separation of Cs-137 and Sr-90, 16: 17336
LEAN, G. H., Measurement of sand transport, 16: 16588
LEBEDEV, K. A., Intraosseous introduction of bone marrow, 16: 16291
LEBEDINSKII, A. V., Effects of radiation on vegetative nervous system, 16: 16280
LEBEY, O., Conference on elementary particles, Aix-en-Provence, Sept. 1961, 16: 16925 (NP-11592(Vol.I))
LEBEY, O., Conference on elementary particles, Aix-en-Provence, Sept. 1961, 16: 16993 (NP-11592(Vol.II))
LEBOUTET, Hubert P., Device for separating electrons, 16: 17173
LE CLERC, P., Studying wear of refractory linings, 16: 16066
LEDERER, Marianne, Determination of total-body K, 16: 16157
LEDOUX, P., External layers of intrinsic variable stars, 16: 16905
LEE, A. R., Charge transfer collisions, 16: 16868
LEE, T. D., Lepton physics, 16: 16995 (NP-11592(Vol.II)(p.15-19))
LEE, W. B., Nitrosyl chloride solar fuel cell system, 16: 16480 (WADD-TR-60-821(Pt.II))
LEE, Warren G., Isotope effect in iodide determination, 16: 16376
LEES, G. W., Tripping circuit, 16: 17282
LEGEN'KAYA, L. M., Influence of radon water on gastric function, 16: 16209
LEGROS, M., Antiproton-proton total cross sections, 16: 16963 (NP-11592(Vol.I)(p.283-6))
LEHMANN, P., Electron-proton scattering, 16: 16942 (NP-11592 (Vol.I)(p.139-40))
LEHMANN, P., Proton scattering in region 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))
LEHNERT, B., Plasma stability, 16: 17193
LEIGHTON, Geoffrey James, Density measuring apparatus, 16: 16565
LEIGHTON, Robert B., Velocity fields in solar atmosphere. I., 16: 16897
LEIMDOERFER, M., Bibliography on (n,n) and (n,2n) reactions, 16: 17074 (VDIT-50)
LEISI, H. J., Monoenergetic positrons in Bi-205, 16: 17096
LEISI, H. J., Monoenergetic positrons in Eu-152, 16: 17097
LEITNAKER, James M., Dissociation pressure of UC$_2$, 16: 16352
LEITTEN, C. F., JR., Brazing alloys for stainless steel fuel elements, 16: 16675 (ORNL-2834)
LEKSELL, Lars, Cerebral radiosurgery, 16: 16246
LEMCOE, M. M., Handbook on elastomeric materials, 16: 16302 (ASD-TR-61-234)
LEONT'EV, N. I., Plasma instability in toroidal discharge, 16: 17206
LEONTIC, B., Hyperon production in π-p collisions, 16: 16979 (NP-11592(Vol.I)(p.385-8))
LERNER, M. W., Determination of Sn and Mo in materials, 16: 16314
LEROY, Francis, Kinetics of oxidation of Mg in humid O$_2$, 16: 16348
LEVEQUE, A., Pion production by π^+, 16: 16930 (NP-11592(Vol.I) (p.27-35))
LEVEQUE, A., Proton scattering in region 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))
LEVIN, V. V., Protective properties of water, polyethylene, and Plexiglas, 16: 17059
LEVINE, M. A., Gas breakdown using secondary electrons, 16: 16801 (AFCRL-62-239)
LEVITT, Leo, Monte Carlo study of resonance escape, 16: 17237 (NASA-TN-D-1184)
LEVY, Gerald, Propagation properties of nonuniform ionized media, 16: 17179 (RADC-TN-61-99)
LEVY, R. H., Solutions to linearized MHD flow problems, 16: 16806 (BSD-TDR-62-42)
LEWIN, Gerhard, Fast ion gage, 16: 17202
LEYMONIE, C., Self-diffusion in gamma iron, 16: 16049
LIBBY, W. F., Tritium geophysics, 16: 16077
LIBIKOVA, N. I., Excretion of desoxycytidine in radiation sickness,

16: 16293

LIBOWITZ, George G., Zirconium–hydrogen system, 16: 16754

LIDEN, K. V. H., Clinical use of NaI(Tl) body counter, 16: 16161

LIDEN, Kurt V. H., Photon detectors for whole-body counting, 16: 16140

LIDOFSKY, L. J., Nuclear data tables. IV., 16: 17154

LIGHTFOOT, David A., Semiconductors for x- and γ-dosage measurement, 16: 16556

LILLETHUN, E., Elastic and inelastic p-p scattering, 16: 16981 (NP-11592(Vol.I)(p.397-406))

LIMENTANI, S., Antiproton annihilation into two charged pions, 16: 16961 (NP-11592(Vol.I)(p.269-75))

LINCOLN, J. V., Calendar record for IGY, 16: 16817

LINDELL, Bo, "Open-booth" body counter, 16: 16144

LINDGREN, M., Irradiation of brain tumors, 16: 16260

LINDNER, M., Resonance neutron activation measurements, 16: 17072 (PNE-113P)

LIPINSKI, B., Isolation and purification of glycoprotein fraction, 16: 16104 (PAN-252/X)

LIPMAN, N. H., Annihilation in flight of positrons, 16: 16946 (NP-11592 (Vol.I)(p.151-3))

LIPMAN, N. H., Decay rate of negative muons, 16: 16944 (NP-11592 (Vol.I)(p.143-5))

LIPPINCOTT, S. W., Whole-body gamma spectrometry, 16: 16159

LISCO, Hermann, Irradiation effects on rat bones, 16: 16194

LISKOWSKY, Oskar, Bibliography on direct energy conversion, 16: 16808 (NP-11472)

LIU, Robert, Determination of niobium, 16: 16312

LIVANOV, M. N., Sensitivity of nervous system to radiation, 16: 16286

LLORET, A., K_2^0 decay in a Wilson chamber, 16: 16954 (NP-11592 (Vol.I)(p.227-34))

LLOYD, R. A., Phosphorescence in scintillation counting, 16: 16095

LOBASHOV, V. M., Beta decay of Co-60 and Au-198, 16: 17142

LOBASHOV, V. M., Beta decay of Mn-56 and F-20, 16: 17144

LOBKOWICZ, F., Depolarization of a beam of polarized protons, 16: 17167

LOEBICH, Otto, Hfs of forbidden Hg II line, 16: 16878

LOEWENSTEIN, P., Cladding and bonding techniques, 16: 16666

LOEWENSTEIN, P., Fabrication of core materials, 16: 16665

LOMBARD, R., Monoenergetic positron formation coefficient, 16: 17098

LONG, Everett, Improvements in nuclear reactors, 16: 17248

LONTHAN, Rector P., Unsaturated sulfides, 16: 16451

LOO, T. C., Prog. rpt. on stability of spherical shells, 16: 16472 (AROD-2465:1)

LORENZINI, L., Determination of B, Al, Fe, Mn, and Cr in U, 16: 16304 (CNEN-96)

LORIA, A., Antiproton annihilation into two charged pions, 16: 16961 (NP-11592(Vol.I)(p.269-75))

LORIA, A., Pion production by π^+ on protons, 16: 16929 (NP-11592 (Vol.I)(p.25-6))

LOTT, J. R., Ventral root potentials during x irradiation, 16: 16261

LOVASEN, Z., Irradiation of brain in normal rats, 16: 16273

LOW, J. R., Jr., Brittleness of refractory metals, 16: 16705 (62-GC-206)

LOWRIE, Robert, Prog. rpt. on high temperature materials, 16: 16726 (NP-11311)

LUCAS, H. F., Jr., Retention of radium in man, 16: 16171

LUCCHINI, M., S-wave amplitude for the K-π system, 16: 17024

LUDWIG, Oliver G., Elliptical coordinate wave functions, 16: 16845

LUERS, D., K^0 interactions, 16: 16955 (NP-11592(Vol.I)(p.235-9))

LUERS, D., K^0 decays, 16: 16956 (NP-11592(Vol.I)(p.241-5))

LUEST, R., Stability of a plasma Torus, 16: 17194

LUNDBY, A., Hyperon production in π-p collisions, 16: 16979 (NP-11592 (Vol.I)(p.385-8))

LUNDQUIST, N., Modified sucksmith balances, 16: 16513 (AE-64)

LUNGY, G., Structure of dihydrate uranyl nitrate, 16: 16391

LVITSINA, G. M., Seasonal influences on antibiotic sensitivity, 16: 16210

L'VOV, A. N., Resonances in Si^{29}(p,γ)P^{30} reaction, 16: 17145

LYUBIMOV, A. S., Sorption of isotopes by MnO$_2$, 16: 16389

LYUBIMOV, V. A., Decay $\mu \to e + \gamma$, 16: 17056

M

MACBETH, R. V., Burnout analysis. I., 16: 17226 (AEEW-R-117)

MAC DONALD, Norman S., Use of total-body counter facility, 16: 16162

MAC DONALD, R. D., Defected Zy-2 clad UO$_2$ fuel elements, 16: 16776 (CRFD-1067)

MACLEOD, G. R., Proton scattering in region 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))

MACRAE, William, Improvements in nuclear reactors, 16: 17273

MADANSKY, L., Method for determining proton polarization, 16: 16965 (NP-11592(Vol.I)(p.295-9))

MAHLMAN, H. A., Iron(III) molar extinction coefficients, 16: 16387

MAHOUX, G., On π-π interaction phase shifts, 16: 16969 (NP-11592 (Vol.I)(p.331-5))

MAKAROV, E. F., Mössbauer effect in tin-bearing polymer, 16: 16889

MAKI, Kazumi, Quantization of flux in superconductors, 16: 16877

MAKIN, M. J., Hardening caused by gas bubbles, 16: 16711 (AERE-M-1000)

MAKIN, S. M., Segregation in metals, 16: 16052

MAKINODAN, T., Splenic white pulp alteration after antigen injection, 16: 16196

MAKSIMOVA, A. M., Determination of radioactivity in water, 16: 16325

MALAMOS, B., Whole-body counting in clinical studies, 16: 16158

MALKIN, V. I., Cation self-diffusion in silicate melts, 16: 16048

MALKUS, W. V. R., Velocity fields in stellar atmospheres, 16: 16910

MALLEN, Jose, Segregation of impurities in Be, 16: 16740

MALONEY, Joseph C., Cold weather decontamination—McCoy I, 16: 16607 (NDL-TR-24)

MALVANO, R., Photoneutron angular distribution, 16: 17089

MANN, Lloyd G., Beta decay of Sc-44, Zr-95, and Nb-95, 16: 17084

MANNING, G., Elastic and inelastic p-p scattering, 16: 16981 (NP-11592 (Vol.I)(p.397-406))

MAPPER, D., Determination of indium, 16: 16319

MAR, P. G., Radioactive fallout study, 16: 16598 (CNHW(RP-4))

MARAVAL, S., Corrosion by UF$_6$. II., 16: 16695

MARCH, R. H., Inelastic hyperon production with π^-, 16: 16977 (NP-11592(Vol.I)(p.371-4))

MARCH, R. H., On π-π interactions, 16: 16958 (NP-11592(Vol.I)(p.249-56))

MARCHANT, H., Energy levels of F-21 and Ne-25, 16: 17092

MARGERUM, J. D., Nitrosyl chloride solar fuel cell system, 16: 16480 (WADD-TR-60-821(Pt.II))

MARIANESCHI, E., Components for SENN vessel, 16: 17303

MARICHAL, M., Determination of Rhodamine B, 16: 16320

MARIN, P. C., Scattering of μ mesons on electrons, 16: 16945 (NP-11592(Vol.I)(p.147-50))

MARINELLI, L. D., Retention of radium in man, 16: 16171

MARINELLI, Leonides D., Retention of radium in humans, 16: 16147

MARINELLI, Leonides D., Sodium iodide systems, 16: 16135

MARION, Jerry B., Nuclear data tables. IV., 16: 17154

MARIONI, C., S-wave amplitude for the K-π system, 16: 17024

MARIS, Th. A. J., Quasi-free electron-proton scattering. I., 16: 17094

MARIS, Th. A. J., Quasi-free electron-proton scattering. II., 16: 17095

MARSH, M. G., Face seals for rotating shafts, 16: 16484

MARTENS, B. K., Radiation in plant protection, 16: 16110

MARTENSEN, E., Stability of a plasma Torus, 16: 17194

MARTIN, A. J., Electric conductivity of Be, 16: 16749

MARTIN, A. J., Melting and casting of Be, 16: 16651

MARTIN, George, Fast ion gage, 16: 17202

MARTINA, E. F., Lunar surface composition analysis, 16: 16532

MARTINDILL, G. H., Prog. rpt. on use of liquid hydrogen in bubble chambers, 16: 16610 (TID-15422)

MARULLO, L., Changes in oral mucous membrane induced by radiations, 16: 16213

MASON, E. A., Transport properties of dissociating air, 16: 16853

MASON, George W., Separation of Cf from Cm, 16: 16469

MASON, James L., Effect of body intersecting flow channel, 16: 16500 (DC-59-11-57)

MASSEY, J. B., Exposure dose measurements, 16: 16216

MATHE, Gy., Decay scheme of I-131, 16: 17117

MATHIS, D. L., Disintegration of Be, 16: 16373

MATTAUCH, J. H. E., New relative nuclidic masses, 16: 17086

MATTAUCH, J. H. E., 1961 nuclidic mass table, 16: 17087

MATTHEWS, P. T., Baryon resonances as unitary multiplets, 16: 17029

MATTHEWS, P. T., Low-energy pion physics, 16: 16999 (NP-11592 (Vol.II)(p.87-102))

MATTKHIZ, S., Single-particle levels in O-17 and F-17, 16: 17152

MAURICE, Francoise, Segregation of impurities in Be, 16: 16740

MAURIN, Jean, Radiolysis of methane in gaseous phase, 16: 16419
MAUSHART, R., Determination of Pu-239 body burden, 16: 16148
MAUSTELLER, J. W., Determination of C in Na, 16: 16690 (TID-7626(Pt.I)(p.146-9))
MAXWELL, J. A., Applications of the mercury electrode, 16: 16318
MAY, Harold A., Sodium iodide systems, 16: 16135
MAYER, I. P., Rare earth disilicides, 16: 16377
MC CABE, W. J., Mass spectrometer measurements. I., 16: 16581
MC CABE, W. J., Mass spectrometer measurements. II., 16: 16582
MC CALL, Richard C., Photon detectors for whole-body counting, 16: 16140
MC CARROLL, R., Electron capture by α particles, 16: 17035
MC CLURE, George M., Methods and instruments for evaluation of refractory materials, 16: 16572 (ASD-TR-61-74)
McCORKLE, K. H., Preparation of Th oxide particles, 16: 16404
MC CORMICK, E. D., Tripping circuit, 16: 17282
MC DANIEL, R. H., Effects of radiation on mix bis ether, 16: 16780 (NARF-62-3T)
MC DANIELS, D. K., Analysis of cyclotron α particles, 16: 16542
MC DONALD, L., Resistivity of sodium, 16: 16789
MC DOWELL, A. A., Behavioral changes as radiation function, 16: 16267
MC ELROY, M. B., Electron capture by α particles, 16: 17035
MC GERVEY, John D., Pulse resolver using tunnel diodes, 16: 16549
MC HENRY, John R., Method of removing Sr ions, 16: 16467
MC ILLROY, William, Electromagnetic pinch effect for propulsion, 16: 17320 (PPL-116)
MC KAY, C. D., Calculation of thermal utilization, 16: 17238 (NEI-168)
MC KEE, J. M., Liquid metal activities at United Nuclear, 16: 16689 (TID-7626(Pt.I)(p.143-5))
MC KEE, W. E., Nitrosyl chloride solar fuel cell system, 16: 16480 (WADD-TR-60-821(Pt.II))
MC KEOWN, M., Nuclear data tables. IV., 16: 17154
MC LAREN, J. R., Compound in the U–Fe–C system, 16: 16757
MC LAUGHLIN, D. W., Analysis of cylindrical pressure vessel, 16: 16478 (TIM-408)
MC NAIR, A., Half life of Rb-87, 16: 16041
MC NEILL, K. G., Excretion of Cs-137 in human, 16: 16152
MC QUEEN, H. S., Nuclear rocket for space propulsion, 16: 17325
MEADE, R. C., Solvent systems for liquid scintillation counting, 16: 16166
MEDVECZKY, Laszlo, Energy spectrum of Be(α,n) neutron sources, 16: 17060
MEGGERS, William F., Tables of spectral-line intensities, 16: 16337 (NBS-MON-32(Pt.II))
MEHTA, Madan Lal, Nuclear matter at low density, 16: 17063 (CEA-2086)
MEIER, G. W., Indirect fetal irradiation effects, 16: 16272
MEIER, G. W., Irradiation, genetics, and aging, 16: 16269
MEIER, Wilbur L., Composite scintillation crystal, 16: 16893
MELEKHIN, V. N., Vertical focusing in a microtron, 16: 17172
MELLON, M. G., Determination of niobium, 16: 16315
MELTZER, C., Three-pion resonances in π^+-D reactions, 16: 16962 (NP-11592(Vol.I)(p.277-82))
MENCUCCINI, C., Photoproduction of π^0 mesons in H_2, 16: 16926 (NP-11592(Vol.I)(p.9-15))
MENCUCCINI, C., Polarization of protons from $\gamma + p \to \pi^0 + p$, 16: 16927 (NP-11592(Vol.I)(p.17-20))
MENDELSSOHN, K., Thermal conductivity of Ta and Nb, 16: 16874
MENEELY, George R., Whole-body-counter data processing, 16: 16154
MENKE, K. H., Assay of H^3-labeled substances, 16: 16096
MENOTTI, P., Low energy p-n scattering and p-p interactions, 16: 16973 (NP-11592(Vol.I)(p.351-4))
MEREDITH, John L., Cold weather decontamination—McCoy I, 16: 16607 (NDL-TR-24)
MEREDITH, W. J., Exposure dose measurements, 16: 16216
MERKINA, T. N., Excretion of desoxycytidine in radiation sickness, 16: 16293
MERKOVA, M. A., Nervous system and internal organs following Rn therapy, 16: 16207
MERLO, J. P., Neutral processes in π^--p interaction, 16: 16932 (NP-11592(Vol.I)(p.45-55))
MERRIAM, M. F., Prog. rpt. on high-temperature semiconductors, 16: 16799 (AD-265462)
MERZBACHER, E., Single valuedness of wave functions, 16: 17007
MESSIER, Jean, Influence of PP^+ junction on particle detector, 16: 16546
MESTRE, Emile, Storage of plugs and devices from reactors, 16: 17331 (CEA-2084)
MEUNIER, R., Hyperon production in π-p collisions, 16: 16979 (NP-11592(Vol.I)(p.385-8))
MEYER, J., Pion production by π^+, 16: 16930 (NP-11592(Vol.I)(p.27-35))
MEYER, J., Proton scattering in region 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))
MEZZETTI, L., Photoproduction of π^+ mesons in H_2, 16: 16928 (NP-11592(Vol.I)(p.21-4))
MIARI, G., Selection rule $\Delta Q = \Delta S$, 16: 16953 (NP-11592(Vol.I)(p.209-15))
MICHALLET, Michel, Reaction of UF_6 with other halides, 16: 16334 (CEA-2110)
MIDDELKOOP, W. C., Photon production in p-p collisions, 16: 16934 (NP-11592(Vol.I)(p.73-7))
MIDDLETON, R., Energy levels of F-21 and Na-25, 16: 17092
MILLER, Allen, Elementary excitations in liquid He, 16: 17061 (AROD-431:45)
MILLER, C. E., Evaluation of multiple-crystal arrays, 16: 16138
MILLER, C. E., Retention of radium in man, 16: 16171
MILLER, Charles E., Retention of radium in humans, 16: 16147
MILLER, Charles E., Total-body potassium in man, 16: 16151
MILLER, David B., Experimental induction plasma accelerator, 16: 17321
MILLER, G. E., The Szilard-Chalmers reaction in bromoethane, 16: 16422
MILLER, Herman L., Neutron measurement methods, 16: 17058 (NYO-7877(Rev.1))
MILLER, J. M., Shield of Illinois Univ. Triga Mark II reactor, 16: 17310 (ORNL-TM-178)
MILLER, R., Prog. rpt. on radiation-resistant materials, 16: 16707 (AD-265319)
MILLER, Sidney I., Isotope effect in iodide debromination, 16: 16376
MILLER, W. N., Creep tests on alpha U, 16: 16770
MILLS, L. E., Welding sintered Al powder materials, 16: 16699 (HW-72379)
MILNE, A. A., Tracers in lubrication research, 16: 16063
MINAMI, Shigeo, Heavy mesons and hard core, 16: 17044
MINAMI, Shigeo, K meson reactions at high energy, 16: 17043
MINAMI, Shigeo, $\Lambda\Sigma$-parity and K^--p interactions, 16: 17042
MINDER, Walter, Calcium assimilation in bone, 16: 16232
MINER, W. N., Plutonium–Al phase diagram, 16: 16750
MINGUZZI, A., Dispersion relations and stability conditions, 16: 17023
MINGUZZI-RANZI, A., V^0 pairs produced in propane bubble chamber, 16: 16938 (NP-11592(Vol.I)(p.101-10))
MIQUEL, J., Glycogen in rat brain after irradiation, 16: 16275
MISELYUK, E. G., Diffusion in germanium, 16: 16057
MISHIMA, Nobuhiko, Resonance in pion production process, 16: 17036
MITTER, H., "New Tamm-Dancoff" approximation, 16: 16850
MITTRA, I. S., K^0 interactions, 16: 16955 (NP-11592(Vol.I)(p.235-9))
MITTRA, I. S., K^0 decays, 16: 16956 (NP-11592(Vol.I)(p.241-5))
MIYAMOTO, Yoneji, K^--p reaction at threshold, 16: 17040
MODRZEJEWSKI, A., Cubic-hexagonal transformation in Co, 16: 16731 (PAN-246/I-B)
MODRZEJEWSKI, A., Kossel line studies of irradiated Ni crystals, 16: 16786
MOFFAT, J. W., On pion-pion scattering, 16: 16971 (NP-11592(Vol.I)(p.343-6))
MOGUTNOV, B. M., Cation self-diffusion in silicate melts, 16: 16048
MOHL, A. N., Sample bottles and bottle-sealing methods, 16: 16474 (MCW-1455)
MOHR, Paul H., Emission spectrometer, 16: 16570
MOISEITSEV (MOISEYTSEV), P. I., Regulations of work with radioactive substances, 16: 16612 (JPRS-12823)
MOLCHANOVA, V. A., Radiation in plant protection, 16: 16110
MOLINARI, Photoneutron angular distribution, 16: 17089
MOLINARI, Jacques, Solid state processing of massive UN, 16: 16452 (CEA-2103)
MOMMEN, Pierre Paul, Improvements in manufacture of isotopes, 16: 16447
MONDA, Mineo, Resonance in pion production process, 16: 17036
MONTANET, L., Proton scattering in region 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))
MONTMORY, M. C., Rare-earth ruthenates, 16: 16837

MONTUELLE, Jean, Structure of stainless steel of 18/8 type, 16: 16739
MOORE, D. G., Process for applying ceramic and cermet coatings, 16: 16641 (ARL-59)
MORELAND, Donald E., Preparation of labeled compounds for counting, 16: 16412
MORGAN, C. R., Mechanism of Cannizzaro reaction, 16: 16087
MOROZ, L. M., Recrystallization and phase transformations, 16: 16050
MORRIS, D. F. C., Determination of Ru in Pt, 16: 16326
MORRIS, Peter R., Irradiation growth in alpha U, 16: 16788
MORRISON, D. R. O., Interactions of protons and π^- in H_2, 16: 16982 (NP-11592(Vol.I)(p.407-17))
MORTON, J. R., Spin resonance spectrum of $CH_3CH(CO_2H)$, 16: 16429
MORTREUIL, M., Radiolabeling of ants, 16: 16111
MOSHINSKY, Marcos, Supermultiplet theory. I., 16: 17112
MOSKALEV, V. I., Mesic atom processes in H_2, 16: 16884
MOSKVIN, A. I., Plutonyl in aqueous solutions, 16: 16393
MOSS, M., Studies of crystal imperfections, 16: 16058
MOUSSEZ, C., Synthesis of thermal tests, 16: 16501 (EURAEC-147)
MUELLER, A., Radiation-produced radicals, 16: 16434
MUELLER, John J., Nuclear fuel elements, 16: 17276
MULVEY, J. H., Antiproton annihilation into two charged pions, 16: 16961 (NP-11592(Vol.I)(p.269-75))
MUNDINGER, F., Bismuth-206 in localization of intracranial lesions, 16: 16249
MUNN, Peter Neil, Improvements in reactors, 16: 17267
MURIN, A. N., Chemical state of P-32 in irradiated KCl, 16: 16411 (AEC-tr-5055)
MURIN, A. N., Yield of spallation and fission products, 16: 17133
MURPHY, P., K^+-nucleon total and differential cross-sections, 16: 16957 (NP-11592(Vol.I)(p.247))
MURTHY, V. Rama, Information of solar system and nucleosynthesis, 16: 16901
MUSCHLITZ, E. E., Jr., Ion source for low-energy negative ions, 16: 16559
MUTH, H., Radium and thorium burdens, 16: 16146
MYERS, H. P., Irradiation effects in pressure vessel steel, 16: 16773 (AE-65)
MYERS, H. P., Modified sucksmith balances, 16: 16513 (AE-64)

N

NAGAMIYA, Takeo, Modification of spin screw structure, 16: 16829
NAGLE, Richard J., Beta decay of Sc-44, Zr-95, and Nb-95, 16: 17084
NAGY, Zs., Toxic effects of x-ray on *E. coli*, 16: 16297
NAIR, K. K., Effects of radiation on housefly pupae, 16: 16124
NAKAJIMA, Kiyoshi, Wear studies in shearing process, 16: 16067
NAKAZAWA, Kazo, Pion-pion interaction, 16: 17037
NARASAPPAYA, N., Cosmic ray produced P-32, P-33, Be-7, and S-35, 16: 16589
NARAYANAN, T. K. S., Schmidt number for hydrogen, 16: 16822
NARCHAL, Mohan Lal, Effect of finite probability of detection field on enhancement of Raser, 16: 16517 (AFOSR-1794(p.15-44))
NARCHAL, Mohan Lal, Theoretical study of solid state Raser, 16: 16515 (AFOSR-1794)
NASH, W. F., Momentum spectrum of μ mesons, 16: 16919
NATALI, S., Selection rule $\Delta Q = \Delta S$, 16: 16953 (NP-11592(Vol.I)(p.209-15))
NATHANS, R., Alloys of the first transition series, 16: 16838
NAUTA, H., Water flow in oil field, 16: 16074
NAYMARK, Sherman, Nuclear power plants for space, 16: 17327
NAZARENKO, V. A., Beta decay of Co-60 and Au-198, 16: 17142
NAZARENKO, V. A., Beta decay of Mn-56 and F-20, 16: 17144
NAZAROV, P. P., Separation of Pa from Zr, Ti, and Nb, 16: 16396
NEEL, Louis, Ordered Fe–Ni structure from neutron irradiation, 16: 16782
NE'EMAN, Yuval, Gauges, groups, and theory of strong interactions, 16: 17066 (IA-698)
NEHER, Dean R., Gammas from proton capture of Mg-25, 16: 17103
NELSON, E. B., Reaction $P^{31}(p,\gamma)S^{32}$, 16: 17090
NELSON, Robert A., Prog. rpt. on UO_2 powders, 16: 16730 (ORO-543)
NELSON, S. D., Sample bottles and bottle-sealing methods, 16: 16474 (NCW-1455)
NERESON, N. G., Neutron diffraction studies on Eu, 16: 16836
NESMEYANOV, A. N., Reaction of tritium recoil with benzene, 16: 16442
NESTOR, C. W., Jr., MURGATROYD—program for analysis of MSRE, 16: 17239 (ORNL-TM-203)
NEUDACHIN, V. G., Dipole absorption of γ quanta, 16: 17109
NEUDACHIN, V. G., Single-particle levels in O-17 and F-17, 16: 17152
NEUSEL, Robert, Eigenvalues of spin Hamiltonian, 16: 16516 (AFOSR-1794(p.1-14))
NEUSEL, Robert, Theoretical study of solid state Raser, 16: 16515 (AFOSR-1794)
NEVEU, G., Study of UO_2F_2–H_2O–HF compounds, 16: 16333 (CEA-2106)
NEWCOMBE, Howard B., Genetic effects in populations, 16: 16225
NEWELL, Reginald E., Transport of substances in atmosphere, 16: 16584
NEWMAN, Leonard, Determination of oxygen in Na, 16: 16688 (TID-7626(Pt.I)(p.141-2))
NICHOLLS, J. G., Presynaptic failure after x irradiation, 16: 16258
NICHOLS, B. H., Astronautics information, Vol. 3, No. 3, 16: 17318 (NP-11493)
NICHOLSON, P. W., Coincident γ rays of Pt-194, 16: 17118
NIEUWENHUYS, Louis, Improvements in manufacture of isotopes, 16: 16447
NIEWODNICZANSKI, J., Potassium salts prospecting, 16: 16044
NIKITIN, S. A., Magnetostriction of Dy, 16: 16882
NIKOLAEVA, N. M., Ion exchange in uranyl carbonate solutions, 16: 16395
NIKOLIC, M., Elastic scattering of protons on H_2, 16: 16939 (NP-11592(Vol.I)(p.111-15))
NIR, A., Scintillation counting of tritium, 16: 16094
NISHIDA, Minoru, Evolution of Population II stars, 16: 16915
NISHIMURA, Edwin T., Protection of lethally x-irradiated mice, 16: 16289
NO, Seng-ch'ang, Radioactive nuclei in region of filled $1f_{7/2}$ shell, 16: 17148
NORMAN, N., Metallic oxide phases of Nb. II., 16: 16745
NOTLEY, M. J. F., Defected Zy-2 clad UO_2 fuel elements, 16: 16776 (CRFD-1067)
NOVAK, L., Metabolic reactivity of irradiated organism, 16: 16284
NOVIKOV, L. S., Phosphorus-32 β spectrum, 16: 17143
NOVIKOV, V. M., Excitation of nuclear levels in μ-mesic atoms, 16: 17151
NOWAK, Melville B., Inspection and testing, 16: 16668
NOYES, Robert W., Velocity fields in solar atmosphere. I., 16: 16897
NOZAKI, Tadashi, Preparation of high-purity silicon, 16: 16075
NOZIERES, Philippe, Elementary excitations in liquid He, 16: 17061 (AROD-431:45)
NUSSBAUM, M., Three-pion resonances in π^+-D reactions, 16: 16962 (NP-11592(Vol.I)(p.277-82))
NYAGU, D. V., Hyperon production in Pb by K_2^0 mesons, 16: 17051

O

OBERHAUSEN, E., Radium and thorium burdens, 16: 16146
OBERNIK, H., Electroluminescence of CdS single crystals, 16: 16858
OBERTHIN, Hans, Determination of niobium, 16: 16312
O'BOYLE, Dennis, Surface coatings for Be parts, 16: 16653
O'BRIEN, B. J., Levels of tritium in New Zealand, 16: 16078
O'BRIEN, B. J., Measurement of natural tritium levels, 16: 16101
OBUKHOV, Yu. V., Decay $\mu \to e + \gamma$, 16: 17056
O'DELL, F. P., Reactivity change calculations, 16: 17240 (TRG-Report-130)
OESTBERG, Gustaf, Hydride solubility in Zr, Zy-2, and Zy-4, 16: 16752
OESTLUND, G., Hydrogen gas counting system, 16: 16100
OESTLUND, H. G., Enrichment of D and T, 16: 16083
OGBORN, Richard E., Labeling pharmaceutical compounds, 16: 16443
OGILVIE, R. E., Kossel line studies of irradiated Ni crystals, 16: 16786
OGITA, Naofumi, Study on extensive air showers, 16: 16920
OGLOBLIN, A. A., Spectra of tritons in reactors, 16: 16090
OI, N., Separation of U from fission products, 16: 16459
OKADA, M., Self-shielding effect in neutron activation, 16: 16415
OKAI, Seeji, Scattering of nucleons by nuclei, 16: 17101
OKONOV, E. O., Hyperon production in Pb by K_2^0 mesons, 16: 17051
OLD, Bruce S., Fuel-element economics, 16: 16672
OLDS, Geoffrey Charles Edward, Improvements relating to Zr alloys, 16: 16772
OLIVEIRA, R. G., Monitoring vibrations from Gnome, 16: 16576 (PNE-129F)
OLSEN, C. E., Neutron diffraction studies on Eu, 16: 16836
OMEL'YANENKO, L. M., Nervous system and internal organs following Ra therapy, 16: 16207

OMNES, R., On π-π interaction phase shifts, 16: 16969 (NP-11592(Vol.I)(p.331-5))
OMNES, Roland, Pion-nucleon interactions, 16: 16989 (NP-11592(Vol.I)(p.467-83))
OMEDA, Sadao, Strangeness violating weak interactions, 16: 17048
OPHEL, T. R., De-excitation of doublet in Al-27, 16: 17129
OPHIR, D., Array for investigation of air showers, 16: 16514 (AFCRL-1092)
ORCUTT, F. D., Gas pressure bonding, 16: 16701
OREN, Y., Array for investigation of air showers, 16: 16514 (AFCRL-1092)
ORLIN, V. N., Dipole absorption of γ quanta, 16: 17109
ORMAN, Z., Efficiency of Al electrolytic cells, 16: 16072
OS'MININ, Yu. P., Thermophysical properties of molten metals, 16: 16741
OSTROM, Thomas R., Decontamination of food and water in nuclear war, 16: 16591 (AD-264822)
O'SULLIVAN, Daniel James, Precipitation chambers, 16: 16566
OSWALD, James Henry, Stable waxing dispersions, 16: 16400
OVERTON, T. R., Plastic scintillator whole-body counter, 16: 16137

P

PAALMAN, H. H., Beryllium sample cell, 16: 16560
PACCANONI, F., $\bar{K}$N and KN energy dependent s-wave scattering lengths, 16: 16974 (NP-11592(Vol.I)(p.355-8))
PACHOWSKA, R., Fluctuations in system depending on random parameters, 16: 17231 (CEA-2115)
PACHUCKI, C. F., Isotopic abundance measurements, 16: 16317
PAGE, J. A., Applications of the mercury electrode, 16: 16318
PAGE, J. P., Liquid metal corrosion research in SNAP, 16: 16681 (TID 7626(Pt.I)(p.87-91))
PAGES, Monique, Radiolysis of aqueous solutions of Pu, 16: 16420
PAGGI, Lamberto, Self engaging couplings, 16: 16487
PAGIOLA, E., $\bar{K}$N and KN energy dependent s-wave scattering lengths, 16: 16974 (NP-11592(Vol.I)(p.355-8))
PAIDASSI, Jean, Kinetics of oxidation of Mg in humid O_2, 16: 16348
PAIR, C. Le, Lambda curves of He-3–He-4 mixtures, 16: 16865
PAL, Yash, Interactions at 150 Bev in C, 16: 17114
PALEANI, P. G., Changes in oral mucous membrane induced by radiations, 16: 16213
PALMER, Thomas A., Separations using sulphosalicylic acid, 16: 16329
PANIN, B. V., Interaction between ions and solids, 16: 16880
PANTANI, Francesco, Ruthenium trichloride in aqueous solutions, 16: 16372
PAOLUZI, L., Photoproduction of π^+ mesons in H_2, 16: 16928 (NP-11592(Vol.I)(p.21-4))
PARAMONOVA, V. I., Ion exchange in uranyl carbonate solutions, 16: 16395
PARKER, G. W., Nuclear orientation experiments, 16: 16061
PARKS, G., Scintillation counting of tritium, 16: 16094
PARRY, G. W., Defected Zy-2 clad UO_2 fuel elements, 16: 16776 (CRFD-1067)
PASQUARELLI, A., End-windowed G-M counter, 16: 16545
PAULEVE, Jean, Ordered Fe–Ni structure from neutron irradiation, 16: 16782
PAUTHENET, R., Magnetic structure work at Grenoble, 16: 16834
PAUTHENET, R., Rare-earth ruthenates, 16: 16837
PAZSIT, Agnes, Radiation protection of accelerators, 16: 17161
PEABODY, C. O., Tritium of atmospheric methane, 16: 16079
PEACOCK, L. J., Radiation effects on behavior, 16: 16265
PEACOCK, L. W., Certification of precision resistance decades, 16: 16527 (SCR-414)
PECK, C., Photoproduction of ω^0 mesons from H_2, 16: 17065 (CTSL-32)
PECKER, J.-C., Aerodynamic phenomena in stellar atmospheres, 16: 16903
PELETMINSKII, S. V., Electron relaxation and electric conductivity of a plasma, 16: 17209
PELMAN, S. G., Radioactive Cs for gamma therapy, 16: 16168
PEMSLER, J. P., Cladding materials, 16: 16661
PEPPARD, Donald F., Separation of Cf from Cm, 16: 16469
PERDRISAT, C. F., Monoenergetic positrons in Bi-205, 16: 17096
PERDRISAT, C. F., Monoenergetic positrons in Eu-152, 16: 17097
PERLEE, H. E., Prog. rpt. on use of liquid hydrogen in bubble chambers, 16: 16610 (TID-15422)
PERLINI, G., Delayed neutron detection in burst can detection, 16: 16523 (CEA-2101)
PERLOW, G. J., Absorption of gamma radiation, 16: 16060
PERLOW, M. A., Liquid metal corrosion research in SNAP, 16: 16681 (TID-7626(Pt.I)(p.89-91))
PERUZZO, L., Pion production by π^+ on protons, 16: 16929 (NP-11592(Vol.I)(p.25-6))
PESSON, P., Entomology research using isotopes, 16: 16132
PESTANER, James F., Measuring radiation tri-directionally, 16: 16567
PETERS, B., Cosmic-ray produced radioactive isotopes, 16: 16587
PETIAU, Gerard, Model for elementary particle systems, 16: 16949 (NP-11592(Vol.I)(p.171-81))
PETMEZAS, G., Hyperon production in π-p collisions, 16: 16979 (NP-11592(Vol.I)(p.385-8))
PETROV, N. I., Hyperon production in Pb by K_1^0 mesons, 16: 17051
PETRUKHIN, V. I., Beta decay probability of π^+ meson, 16: 17057
PETRZHAK, K. A., Neutron inelastic scattering by Ta-181, 16: 17140
PETRZHAK, K. A., Separation of fission fragments from U and Th, 16: 16441
PETSCHEK, H., Current distribution for large radius-ratio mast, 16: 16803 (AFOSR-2194)
PETSCHEK, H. E., Collision-free shock-waves and plasmas, 16: 16912
PEVSNER, A., Three-pion resonances in π^+-D reactions, 16: 16962 (NP-11592(Vol.I)(p.277-82))
PEYROU, Ch., High energy physics above 10 Bev, 16: 17000 (NP-11592(Vol.II)(p.103-24))
PHU SY UY, Structure of stainless steel of 18/8 type, 16: 16739
PIAGGIO, L., Monoenergetic positrons in Eu-152, 16: 17097
PICCHIO, C., Geometric factors of thyroid scanning, 16: 16170
PICCIOTTO, E., Air radioactivity in the Antarctic, 16: 16042
PICKART, S. J., Alloys of the first transition series, 16: 16838
PICKETT, A. G., Handbook on elastomeric materials, 16: 16302 (ASD-TR-61-234)
PICKUP, E., Evidence for π-π resonance, 16: 16960 (NP-11592(Vol.I)(p:265-7))
PIKUS, G. E., Electron mobility in plasma, 16: 17205
PI[L]LAI, T. N. Viswanathan, Handling hazards of natural Th, 16: 16593 (AEET/HP/SM-5)
PILLAT, B., Effects of irradiation on Purkinje fibers, 16: 16279
PINEL, Jacques P., Device for separating electrons, 16: 17173
PINES, David, Elementary excitations in liquid He, 16: 17061 (AROD-431:45)
PINGS, C. J., Beryllium sample cell, 16: 16560
PIRENNE, Jean, Properties of mono-atomic linear chain, 16: 16864
PISANI, G., Effects of radiation on neuron substructure, 16: 16278
PITAEVSKII, L. P., Liquid He-3 transition to superfluid state, 16: 16888
PITZER, Kenneth S., Corresponding states theory for Ar and Xe, 16: 16374
PIZZINI, S., Canning materials for gas-cooled reactor, 16: 17287 (CNI-102)
PLANIOL, Therese, Gamma encephalography in neurosurgery, 16: 16244
POBELL, F., Mössbauer effect in Sn-119, 16: 17138
PODOLSKY, Boris, Crossed field MHD channels, 16: 17188
POHL, R. O., Studies of crystal imperfections, 16: 16058
POKROVSKAYA-SOBOLEVA, A. S., Ignition of gas discharge in H_2, 16: 16883
POLKINGHORNE, J. C., Analyticity and unitarity, 16: 17021
POMERANTZ, M. A., Cosmic ray storm of July 1961, 16: 16917
POMORSKI (POMORSKII), L., Interaction of N-14 and Ne-20 with C, Al, Cu, and Ta, 16: 17153
PONOMAREV-STEPNOI, N. N., Thermal load along reactor channel, 16: 16511
PONS, A., Studying wear of refactory linings, 16: 16066
POPOV, S. N., Role of emission channel in ion source, 16: 16814 (FTD-TT-62-435)
POREMBKA, Stanley W., Jr., Fuel element for neutronic reactors, 16: 17277
POSPISIL, M., Metabolic reactivity of irradiated organism, 16: 16284
POST, Ben, Rare earth disilicides, 16: 16377
POST, H. R., Many-particle systems. III., 16: 17034
POSTERNAK, J. M., Response of visual cortex of cat, 16: 16263
POTAPOV, V. G., Uranyl nitrate extraction by diethyl ether, 16: 16462
POTSAID, Majic S., Studies in wound healing. IV., 16: 16198
POTTASCH, Stuart R., Helium (triplets) in nebulae, 16: 16895

POUJADE, Joseph, Improvements in ionization chambers, 16: 17216

POWELL, A. L., Mechanism of Cannizzaro reaction, 16: 16087

POWELL, W. M., Selection rule $\Delta Q = \Delta S$, 16: 16953 (NP-11592(Vol.I)(p.209-15))

POYET, George, Evaluation of military radiac equipment, 16: 16530 (WT-755)

POZDEEV, V. V., Reaction of tritium recoil with benzene, 16: 16442

POZZI, J. F., Water cooled retort cover, 16: 16673

PRABHAKARA, C., Cosmic ray produced P-32, P-33, Be-7, and S-35, 16: 16589

PRADZYNSKI, A., Efficiency of Al electrolytic cells, 16: 16072

PRATAP, R., Pressure compensated fields, 16: 16638

PRESTON, William M., Proton beam for intracerebral lesions, 16: 16248

PROKOSHKIN, Yu. D., Beta decay probability of π^+ meson, 16: 17057

PROSPERT, Jacques, Exchange properties of Zr phosphate, 16: 16347

PROSSER, F. W., Jr., Gammas from proton capture of Mg-25, 16: 17103

PROTASHCHIK, V. A., Effect of Co-60 on cobalt formate, 16: 16410 (AEC-tr-5054)

PRZEWLOCKI, K., Potassium salts prospecting, 16: 16044

PUISEUX-DAO, Simone, Effect of radiation on *Acetabularia*. IV., 16: 16240

PUSHKAREV, V. V., Sorption of isotopes by MnO_2, 16: 16389

PUSTOVALOV, V. V., Thermal conductivity of refractory materials, 16: 16575 (DC-58-8-38)

Q

QAYYUM, H. A., Insect-control investigations, 16: 16130

QUERZOLI, R., Photoproduction of π^0 mesons in H_2, 16: 16926 (NP-11592(Vol.I)(p.9-15))

QUERZOLI, R., Polarization of protons from $\gamma + p \to \pi^0 + p$, 16: 16927 (NP-11592(Vol.I)(p.17-20))

QUETIER, M., Apparatus for differential thermal analysis, 16: 16522 (CEA-2094)

R

RACZKA, Ryszard, New symmetries in strong interactions, 16: 17127

RADOJICIC, D., Antiproton annihilation into two charged pions, 16: 16961 (NP-11592(Vol.I)(p.269-75))

RADOJICIC, D., Pion production by protons in hydrogen, 16: 16984 (NP-11592(Vol.I)(p.433-47))

RAGHAVAN, R., Interactions at 150 Bev in C, 16: 17114

RAGONE, D. V., Vapor transport of U from UC_2–C compacts, 16: 16721 (GAMD-1233)

RAILEY, R. M., Decontamination of ships surfaces. II., 16: 16611 (USNRDL-TR-549)

RAJALA, B. R., Prog. rpt. on vanadium alloys, 16: 16712 (ARF-2231-3)

RAMAGE, Robert W., High pressure gas regulator, 16: 16569

RAMAKOTESWARA RAO, P., Band spectrum of CuCl molecule. II., 16: 16345

RAMAKOTESWARA RAO, P., Band spectrum of CuCl molecule. III., 16: 16346

RAMAVATARAM, K., Reaction $B^{11}(\alpha,n)N^{14}$, 16: 17119

RANDIC, M., Irradiation of brain in normal rats, 16: 16273

RANDOLPH, H. D., Ion source for low-energy negative ions, 16: 16559

RANSOHOFF, J. A., Engineering aspects of fuel elements, 16: 16664

RAPOPORT, A., Excretion of Cs-137 in human, 16: 16152

RAPPENEAU, J., Apparatus for differential thermal analysis, 16: 16522 (CEA-2094)

RAPPERPORT, E. J., Prog. rpt. on refractory phase diagrams, 16: 16724 (NMI-9238)

RARING, L. M., Alloy of Nb with 1% Zr, 16: 16716 (CNLM-2166)

RASTALL, Peter, Another form of quantum electrodynamics, 16: 16849

RATTI, J. N., Ion source for low-energy negative ions, 16: 16559

RAWSON, D. S., Reconcentration of T by distillation, 16: 16084

RAYNOR, G. V., State of cerium in Th–Ce, 16: 16748

RECTOR, J. H., Axial expansion of lathe spindles, 16: 16473 (HW-71980)

REICH, K. H., Beam transport for high-energy physics, 16: 17160

REID, D. L., Release of radiostrontium from strontium carbonate, 16: 16336 (HW-69692)

REINHEIMER, Julian, Theorems in magnetohydrodynamics, 16: 17330

REISER, Martin, Ion capture in isochronous cyclotron Karlsruhe, 16: 17159 (UCRL-Trans-812)

REIZENSTEIN, P. G., Whole-body gamma spectrometry, 16: 16159

REMAEV, V. V., Short-period isomers Nd-140m, Pm-144m, Eu-146m, and Gd-158m, 16: 17147

REME, Henri, Reaction $Si^{28}(n,\alpha)Mg^{25}$ at 14.6 Mev, 16: 17076

REMENCHIK, Alexander P., Total-body potassium in man, 16: 16151

RENSON, Jean, Radioprotection of mice by 5-hydroxytryptamine and related substances, 16: 16200

RENSON, Pierre, Properties of mono-atomic linear chain, 16: 16864

RESTELLI, G., Excited states of Tl-208 and Po-212, 16: 17082

REVEL, D., Proton scattering in region 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))

REY, C., Capture rate for muons in He, 16: 16943 (NP-11592(Vol.I)(p.141))

REYNOLDS, D. B., Whirl in air-lubricated journal bearings, 16: 16475 (NP-11494)

RHODES, Donald W., Method of removing Sr ions, 16: 16467

RICHARDSON, A. J., Analysis of perforated beams in bending, 16: 16477 (TIM-390)

RICHARDSON, J. Reginald, Techniques of magnetic field measurement, 16: 17165

RICHTER, H., Constitution of Zr–Nb alloys, 16: 16719 (EURAEC-137)

RIECHMANN, G., Analysis of oxygen in alkali metal, 16: 16687 (TID-7626(Pt.I)(p.130-40))

RIEHL, N., Effects of radiation on phosphors, 16: 16792

RIMONDI, O., Calibration of film badges, 16: 16615

RINALDI, R., Blood volume of rat using Cr-51, 16: 16103 (CEA-2112)

RITZ, Heinrich Hugo Ludolf, Fuel elements for nuclear reactors, 16: 17272

RITZ, Victor H., Ionization chamber for source calibration, 16: 16554

RIVET, P., K_2^0 decay in a Wilson chamber, 16: 16954 (NP-11592(Vol.I)(p.227-34))

ROACH, K. E., Theoretical analysis of SSCR. I., 16: 17227 (BAW-1230(Pt.I))

ROBERTS, L. D., Nuclear orientation experiments, 16: 16061

ROBERTS, P. H., Propagation of gravity waves along conducting fluid, 16: 16899

ROBERTSON, L. P., Capture of protons by deuterons, 16: 17010

ROBINS, R. G., Crystal habit of UO_2, 16: 16759

ROBINSON, D. K., Evidence for π-π resonance, 16: 16960 (NP-11592(Vol.I)(p.265-7))

ROBINSON, G. W., Excitation migration in organic crystals, 16: 16379

ROBINSON, S. T., Discharge valve for granular material, 16: 17280

RODIER, J., Safety apparatus for radioactive accidents, 16: 16597 (CEA-2113)

RODIN, Max B., Reactor having NaK–UO_2, 16: 17281

ROGERS, L. B., Determination of niobium, 16: 16327

ROGERS, L. B., Determination of tantalum, 16: 16328

ROGINSKII, S. Z., Properties of radioactive substance sorption, 16: 16440

ROIZEN, I. I., Interference between amplitudes of inelastic processes, 16: 17055

ROLF, Howard L., Whole-body-counter data processing, 16: 16154

ROLL, I. B., Thorium and its alloys, 16: 16659

ROMANO, A., Corrosion studies in Hg and Na systems, 16: 16677 (TID-7626(Pt.I)(p.23-34))

ROMANOVSKII, E. A., Proton inelastic scattering on Ca-40 and Mn-55, 16: 17146

RONNE, B. E., Antiproton interaction cross sections, 16: 16922 (AD-261903)

ROOK, J. R., Imaginary part of optical potential, 16: 17104

ROSA, G., End-windowed G-M counter, 16: 16545

ROSE, G. S., Wire explosions in air, 16: 16844

ROSEN, D., Frog nerve-muscle following irradiation, 16: 16257

ROSENBERG, R. L., Irreversible processes in ionized gases, 16: 16820

ROSI, F. D., Prog. rpt. on thermoelectric materials, 16: 16708 (AD-266128)

ROSSI, H. H., Radiation energy in the cell, 16: 16229

ROTA, A., Excited states of Tl-208 and Po-212, 16: 17082

ROTH, John A., Working fluids program, 16: 16685 (TID-7626(Pt.I)(p.111-14))

ROTHLEDER, B. W., Performance of operational fuel elements, 16: 16669

ROTHWELL, E., Release of Kr-85 from irradiated UO_2, 16: 16756

ROULT, G., Magnetic structure work at Grenoble, 16: 16834
ROUSE, Carl A., Ionization equilibrium equation of state. II., 16: 16818
ROZANOVA, A. M., Hyperon production in Pb by K_1^0 mesons, 16: 17051
ROZENBERG, J., Formation of gases and H_2O_2 in Triton water, 16: 16332 (CEA-2088)
RUBIN, A. G., Gas breakdown using secondary electrons, 16: 16801 (AFCRL-62-239)
RUDERMAN, H., Photoproduction of ω^0 mesons from H_2, 16: 17065 (CTSL-32)
RUGH, R., Irradiation of developing embryo, 16: 16270
RUGH, Roberts, Effects of irradiation of mammalian embryo, 16: 16212
RUMER, Yu. B., Gravitational wave field theory, 16: 17225
RUNCIMAN, W. A., Electrostatic energy matrices, 16: 16356
RUNDO, J., Whole-body gamma spectrometers, 16: 16139
RUSAKOV, V. A., Hyperon production in Pb by K_1^0 mesons, 16: 17051
RUSSELL, L. E., Sintering behavior in PuO_2–UO_2 system, 16: 16753
RYAN, James F., Fast acting current switch, 16: 17219
RYKALIN, V. I., Beta decay probability of π^+ meson, 16: 17057
RYON, J. W., Gas suspension nuclear fuel assembly, 16: 17278
RYS, F., Monoenergetic positron formation coefficient, 16: 17098

S

SACHS, Georg, Low cycle fatigue, 16: 16767
SACTON, Hyperfragments from interactions of K^- mesons with emulsion nuclei, 16: 16976 (NP-11592(Vol.I)(p.363-9))
SAILLEAU, J., Mercury porosimeter for nuclear graphite, 16: 16521 (CEA-2093)
SAITO, K., Isotopic exchange of gallium, 16: 16363
SAKAMOTO, Yoshiyuki, Deuteron elastically scattered by nuclei, 16: 17130
SAKASHITA, Shiro, Origin of planetary nebulae, 16: 16914
SALAM, A., Baryon resonances as unitary multiplets, 16: 17029
SALAM, A., Consequences of the unitary symmetry, 16: 17030
SALAM, Abdus, Strange isobars, 16: 17005 (NP-11592(Vol.II)(p.191-204))
SALANT, E. O., Evidence for π-π resonance, 16: 16960 (NP-11592(Vol.I)(p.265-7))
SALLER, Henry A., Fuel element for neutronic reactors, 16: 17277
SALMON, G. L., Bombardment of O-16 and F-19 with protons, 16: 17088
SALVINI, G., Photoproduction of π^0 mesons in H_2, 16: 16926 (NP-11592(Vol.I)(p.9-15))
SALVINI, G., Polarization of protons from $\gamma + p \to \pi^0 + p$, 16: 16927 (NP-11592(Vol.I)(p.17-20))
SAMOILOV, O. Ya., Uranyl nitrate extraction by diethyl ether, 16: 16461
SAMORAJSKI, T., Histochemical studies on mouse brains, 16: 16276
SAMPANTHAR, S., Binding energies of Λ particles, 16: 17015
SAMPSON, J. B., Geometric effects in HTGR annual resonance integral calculations, 16: 17295 (GAMD-2660)
SAMSONOV, G. V., Silicides in engineering, 16: 16341 (FTD-TT-61-409)
SANJEEVAIAH, B., Hyperfragments from interactions of K^- mesons with emulsion nuclei, 16: 16976 (NP-11592(Vol.I)(p.363-9))
SANO, Mitsuo, Nuclear reactions and optical model, 16: 17132
SANTANGELO, R., Antiproton annihilation into two charged pions, 16: 16961 (NP-11592(Vol.I)(p.269-75))
SANTANGELO, R., Pion production by π^+ on protons, 16: 16929 (NP-11592(Vol.I)(p.25-6))
SANTON, Lucien, Velocity distribution in water stream, 16: 16510
SANTORO, A., Effects of radiation on neuron substructure, 16: 16278
SARGENT, Thornton W., Metabolic studies with Fe-59, Ca-47, and C-11, 16: 16160
SARNAT, Marlene, Determination of radioactive Ca, 16: 16316
SASAKI, Hiroshi, Field errors of magnets for synchrotron, 16: 17164
SATA, Toshio, Wear studies in shearing process, 16: 16067
SATO, M., Radiation effects on spinal cord of cat, 16: 16262
SATO, T., Properties of Pa(V) in H_2SO_4, 16: 16365
SAULIT, V. R., Focusing flat monoenergetic ion beam, 16: 17170
SAUNDERS, Frank Linwood, Stable waxing dispersions, 16: 16400
SAWAI, Sadamu, JRR-2 cooling tower test, 16: 17307 (JAERI-1022)
SAXENA, S. C., Schmidt number for hydrogen, 16: 16822
SAYIED, A. M., Cherenkov effect, 16: 17033
SAYLOR, John C., Radiation-resistant silicone rubber, 16: 16303
SCARGILL, D., Nitratonitrosylruthenium complexes, 16: 16381
SCHADEK, Janos, Beta-ray band spectrograph. III., 16: 16538
SCHADLER, H. W., Brittleness of refractory metals, 16: 16705 (62-GC-206)
SCHAEFER, Hermann J., Dosimetry of ionizing radiation in space, 16: 16188
SCHAEFFER, O. A., Meteorites as space probes, 16: 16038
SCHAERF, C., Photoproduction of π^+ mesons in H_2, 16: 16928 (NP-11592(Vol.I)(p.21-4))
SCHAMBRA, Philip E., Effects of accelerated heavy ions, 16: 16189
SCHARBERT, T., Decay scheme of I-131, 16: 17117
SCHARPENSEEL, H. W., Assay of H^3-labeled substances, 16: 16096
SCHATZMAN, E., Propagation of a shock wave, 16: 16906
SCHEEL, Nivard, Interaction of alkali metal with rare gas, 16: 16353
SCHEER, Milton D., Dissociation energies of Cs halides, 16: 16358
SCHENCK, H. N., Jr., Acoustical behavior of heat exchangers, 16: 16505 (TIM-280)
SCHIFFMAN, T. H., Loading on building and equipment shapes, 16: 16574 (WT-721)
SCHIMMEL, Wolfgang, Producing nuclear reactor fuel, 16: 17275
SCHLEIN, P., Three-pion resonances in π^+-D reactions, 16: 16962 (NP-11592(Vol.I)(p.277-82))
SCHLENKER, L. D., Reaction $P^{31}(p,\gamma)S^{32}$, 16: 17090
SCHLUDERBERG, D. C., Gas suspension nuclear fuel assembly, 16: 17278
SCHLUETER, Robert J., Erythropoietic factor purification, 16: 16164
SCHLUMBOHM, H., Spatial expansion of a discharge, 16: 17204
SCHMID, Gerhard, Production of membrane filters, 16: 16490
SCHMIDLIN, P., Radiation age of meteorites, 16: 16039
SCHMIDT, C. H., Metabolism of insecticides in animals, 16: 16115
SCHMIDT, C. H., Radiation in insect control, 16: 16127
SCHMIDT, F. H., Positron polarization in Fermi-type transition, 16: 16059
SCHNEEBERGER, R., Elastic scattering of protons on H_2, 16: 16939 (NP-11592(Vol.I)(p.111-15))
SCHNEIDER, Harold, Monte Carlo study of resonance escape, 16: 17237 (NASA-TN-D-1184)
SCHOCK, Alfred, Prog. rpt. on thermionic power generator, 16: 16810 (PPL-TR-61-22)
SCHOPPER, H., Beta decay of Nb-95, 16: 17085
SCHRADER, C. D., Lunar surface composition analysis, 16: 16532
SCHROEDER, F., Prog. rpt. on Spert project, 16: 17235 (IDO-16750)
SCHUERENKAEMPER, A., Diffusion of fission gases in UO_2, 16: 16650 (EURAEC-194(App.7))
SCHUMACHER, B. W., Pressure stages for high-pressure/high-vacuum systems, 16: 16813 (UTIA-78)
SCHWARTZ, M., Reaction $\pi^- + p \to \Lambda^0 + K^0$ at threshold, 16: 16952 (NP-11592(Vol.I)(p.203-7))
SCOTT, M., Prog. rpt. on producibility of Ti–Al–Zr alloys, 16: 16706 (AD-264434)
SCOTT, T. A., NQR of N-14 in solid N_2, 16: 16354
SCRIBNER, Bourdon F., Tables of spectral-line intensities, 16: 16337 (NBS-MON-32(Pt.II))
Seb, To Ying
see *To, Ying-seb*
SEDLETSKII, R. V., Separation of fission fragments from U and Th, 16: 16441
SEGAR, A. M., Capture rate for muons in He, 16: 16943 (NP-11592(Vol.I)(p.141))
SEMMEL, J. W., Jr., Liquid metal investigations, 16: 16680 (TID-7626(Pt.I)(p.69-86))
SEREBRYAKOV, V. V., Equations for low-energy pion-pion scattering, 16: 17054
SEREDIN, P. I., Forging uranium, 16: 16700 (JPRS-13099)
SEVERNYI (SEVERNY), A. B., Velocity fields in stellar atmospheres, 16: 16911
SEVIER, Kenneth D., Stopping of Cf-252 fission fragments, 16: 17078
SEVIN, Eugene, Loading of horizontal cylindrical shapes, 16: 16481 (WT-722)
SHAFRANOVA, M. G., Proton-proton elastic scattering at 2.8 Bev, 16: 17050
SHAFROTH, S. M., Nuclear data tables. IV., 16: 17154
SHAKHBAZYAN, B. A., Proton-proton elastic scattering at 2.8 Bev, 16: 17050
SHAMU, R. E., Disintegration of Ne by neutrons, 16: 17099

SHAMU, R. E., High-pressure gas scintillation counters, 16: 16544
SHAPLEY, A. H., Calendar record for IGY, 16: 16817
SHARPE, J., Photomultipliers for tritium, 16: 16092
SHASHKOV, V. S., Radioprotective effect in combined preparations, 16: 16296
SHAVTVALOV, L. Ye., Radioactive nuclei in region of filled $1f_{7/2}$ shell, 16: 17148
SHAW, P. F. D., The Szilard-Chalmers reaction in bromoethane, 16: 16422
SHAW, R. C., Hastelloy convection NaK corrosion loop tests, 16: 16691 (TIM-435)
SHAW, R. C., Stainless steel–sodium corrosion loop tests, 16: 16692 (TIM-490)
SHEARIN, P. E., Low-temperature radiation damage studies, 16: 16795
SHEHATA, A. M. El-Tabey, Radiosensitivity of *Escherichia coli*, 16: 16220
SHEIDINA, L. D., Adsorptive properties of Pa, 16: 16388
SHELINE, Raymond K., Spectra of deformed even nuclei, 16: 17108
SHELLHASE, E. C., Effects of radiation on mix bis ether, 16: 16780 (NARF-62-3T)
SHEN, S. P., Shielding of cosmic rays, 16: 16187
SHERMAN, H. J., Pion production by protons in hydrogen, 16: 16984 (NP-11592(Vol.I)(p.433-47))
SHEVCHENKO, O. P., Alpha angular distributions from $Li^7(p,\alpha)He^4$, 16: 17141
SHEWCHUCK, Sergey, Cinematography of underground explosions, 16: 16033 (UCRL-Trans-806(L))
SHEWCHUCK, Sergey, Ion capture in isochronous cyclotron Karlsruhe, 16: 17159 (UCRL-Trans-812)
SHEWCHUCK, Sergey, Properties of zirconia, 16: 16736 (UCRL-Trans-791(L))
SHEWCHUCK, Sergey, Turbulent flow of compressed gas in channels, 16: 16507 (UCRL-Trans-785(L))
SHILLING, Arthur William, Fuel elements for reactors, 16: 17265
SHILLING, C. E., Preparation of Th oxide particles, 16: 16404
SHIRKOV, D. V., Equations for low-energy pion-pion scattering, 16: 17054
SHIRKOV, D. V., Highest partial waves in low energy approximation, 16: 17067 (JINR-D-857)
SHIROKOV, M. I., Effective radius of particle interaction, 16: 16923 (JINR-E-859)
SHOR, G. I., Operative properties of lubricating oils, 16: 16064
SHPINEL, V. S., Mössbauer effect in tin-bearing polymer, 16: 16889
SHVEDOV, V. P., Determination of radioactivity in water, 16: 16325
SHVIDKOVSKII (SHVIDKOVSKIY), E. (Ye.) G., Viscosity of fused metals, 16: 16343 (NASA-TT-F-88)
SHWE, Maung Hla, Mean life of π^0 meson, 16: 17006 (UCRL-10118)
SHY, G. Milton, Radioactive localization of intracranial lesions, 16: 16247
SIAUD, J., K_1^0 decay in a Wilson chamber, 16: 16954 (NP-11592(Vol.I)(p.227-34))
SIEBKER, Manfred, Improvements relating to nuclear reactors, 16: 17270
SIEGEL, Benjamin M., Contamination in reflection electron diffraction, 16: 16841
SIGELLE, Robert, Fast counting scaler, 16: 16534
SIKOV, Melvin R., Effects of prenatal radiation on rat, 16: 16221
SILIN, I. N., Determination of coordinates of minima of functionals, 16: 16634 (JINR-D-810)
SILINA, G. F., Beryllium. Chemical technology and metallurgy, 16: 16771
SILVERMAN, G. J., Radiosensitivity of *Escherichia coli*, 16: 16220
SILVERMAN, Joseph, Energy source device, 16: 16891
SILVERMAN, M. S., Skin transplants and blood cells of donor bone marrow, 16: 16178 (USNRDL-TR-553)
SILVERSTEIN, Seth David, Influence of electron interactions on metals, 16: 16713 (AROD-431:44)
SILVESTRINI, G. V., Photoproduction of π^0 mesons in H_2, 16: 16926 (NP-11592(Vol.I)(p.9-15))
SIMON, A., Producing high density plasma, 16: 17218
SIMON, George W., Velocity fields in solar atmosphere. I., 16: 16897
SIMONOV, E. F., Reaction of tritium recoil with benzene, 16: 16442
SIMONS, David G., Biological effects of cosmic radiation, 16: 16192
SIMONS, H. A. B., Gamma penetration of collimating holes, 16: 16217
SIMONS, Lennart, Directional correlations in Pt-192, 16: 17116
SIMSON, Eva, Radioresistant mutants of *E. coli*, 16: 16206
SINGH, J. J., Determination of zirconium, 16: 16322
SINGH, N. L., Excited states of LiH and RbH molecules, 16: 16872
SINGH, N. L., Potential energy curves of Li^7H^1, 16: 16821
SIPPEL, R. J., Bibliography of JPL publications, July 1960–June 1961, 16: 17319 (NP-11568)
SITTE, K., Array for investigation of air showers, 16: 16514 (AFCRL-1092)
SIX, Erich, Effect of radiation on *Acetabularia*. IV., 16: 16240
SIZMANN, R., Effects of radiation on phosphors, 16: 16792
SKILLICORN, I. O., Pion production by protons in hydrogen, 16: 16984 (NP-11592(Vol.I)(p.433-47))
SKVORTSOV, N. S., Electron mobility in plasma, 16: 17205
SLACK, G. A., Studies of crystal imperfections, 16: 16058
SLATTERY, J. C., Plasma potential probe, 16: 17203
SMETS, E., Preparation of UO_2 single crystals, 16: 16652
SMIRNOV, Yu. F., Single-particle levels in O-17 and F-17, 16: 17152
SMITH, A. J., Properties of Pa(V) in H_2SO_4, 16: 16365
SMITH, D. B., Reconcentration of T by distillation, 16: 16084
SMITH, G. H., Electron scattering cross sections, 16: 16866
SMITH, H. A., Separation of H, T, and HT, 16: 16085
SMITH, K. F., Hyperfine structure of Lu-176, 16: 17128
SMITH, P. N., Response of rabbits to nephrotoxic serum, 16: 16195
SNOW, Richard H., Thermochemical data on compounds for energy conversion, 16: 16805 (ARF-3182-5)
SOBKOWSKI, J., Potential of UO_2^{++}–U^{4+} system. II., 16: 16364
SOKOLOV, A. P., Structure of dihydrate uranyl nitrate, 16: 16391
SOKOLOV, S. N., Determination of coordinates of minima of functionals, 16: 16634 (JINR-D-810)
SOLLICH, W. A., Deuterium exchange reactions. III., 16: 16344
SOLMITZ, F. T., Strange isobars, 16: 17004 (NP-11592(Vol.II)(p.177-89))
SOLOV'EV, L. D., Pion-pion interaction, 16: 17052
SOLOWAY, Albert H., Neutron therapy of operatively exposed gliomas, 16: 16250
SOMASUNDARAM, S., Handling hazards of natural Th, 16: 16593 (AEET/HP/SM-5)
SONDEREGGER, P., Neutral processes in π^--p interaction, 16: 16932 (NP-11592(Vol.I)(p.45-55))
SOROKINA, A. V., Neutron inelastic scattering by Ta-181, 16: 17140
SORRELL, C. A., Solid state formation of feldspars, 16: 16578
SOUGI, Michel, Improvements in remote control devices, 16: 16466
SOURIAU, J. M., Cayley octonions and strong interactions, 16: 16948 (NP-11592(Vol.I)(p.169-70))
SOUTHIN, J. L., Mutagenesis in Drosophila. I., 16: 16202
SPALDING, I. J., Hyperfine structure of Lu-176, 16: 17128
SPEARMAN, T. D., Low energy p-n scattering and p-p interactions, 16: 16973 (NP-11592(Vol.I)(p.351-4))
SPEARMAN, T. D., Partial wave amplitudes for ingoing and outgoing particles, 16: 16970 (NP-11592(Vol.I)(p.337-42))
SPEDDING, Frank H., Decontamination of uranium, 16: 16471
SPIERS, F. W., Whole-body counting. Review, 16: 16134
SPITSYN, V. I., Separation of Pa from Zr, Ti, and Nb, 16: 16396
SPITZYN, V. I., Beryllium. Chemical technology and metallurgy, 16: 16771
SPODE, Ernst, Guinea pigs after incorporation of radionuclides, 16: 16237
SPRING, Erik, Directional correlations in Pt-192, 16: 17116
SPROULL, R. L., Studies of crystal imperfections, 16: 16058
SROUB, Kevin J., Monte Carlo study of resonance escape, 16: 17237 (NASA-TN-D-1184)
STACY, John T., Fuel element for neutronic reactors, 16: 17277
STADELMAIER, Hans H., Nitrogen alloys of transition metals, 16: 16768
STAHL, W., Geiger counter for tritium, 16: 16099
STAHL, W. R., Radiation effects on spinal cord of cat, 16: 16262
STANEK, F. W., 84-Kev level in Yb-170, 16: 17135
STANEK, Friedrich W., 80-Kev level of Er-166, 16: 17136
STANLEY, V. A., Photomultipliers for tritium, 16: 16092
STANTON, Leonard, Semiconductors for x- and γ-dosage measurement, 16: 16556
STAREK, I. E., Adsorptive properties of Pa, 16: 16388
STARK, Mary B., Absorbed dose in water, 16: 16555
STEENBECK, Max, Producing nuclear reactor fuel, 16: 17275
STEINER, H., Antiproton-proton total cross sections, 16: 16963 (NP-11592(Vol.I)(p.283-6))
STEINMETZ, H., Liquid metal activities at United Nuclear, 16: 16689

(TID-7626(Pt.I)(p.143-5))
STEKOL'NIKOV, I. S., Nature of the long spark, 16: 17182 (FTD-TT-61-149)
STEPANOV, A. V., Theory of resonance scattering, 16: 16886
STEUDEL, Andreas, Hfs of forbidden Hg II line, 16: 16878
STIENING, R., Photoproduction of π^0 mesons in H_2, 16: 16926 (NP-11592(Vol.I)(p.9-15))
STIERLIN, U., Scattering of μ mesons on electrons, 16: 16945 (NP-11592(Vol.I)(p.147-50))
STIGLITZ, R. A., Solvent systems for liquid scintillation counting, 16: 16166
STINNER, R. J., Lunar surface composition analysis, 16: 16532
STOECKER, H. J., Properties of zirconia, 16: 16736 (UCRL-Trans-791(L))
STOENNER, R. W., Meteorites as space probes, 16: 16038
STOESSL, A., Irradiation of unsaturated sultones, 16: 16437
STONE, Yvonne H., Abundances in A stars. I., 16: 16896
STONER, W. L., Beryllium thermal cycle tests, 16: 16732 (TIM-312)
STOPPA, C., Determination of B, Al, Fe, Mn, and Cr in U, 16: 16304 (CNEN-96)
STOUGHTON, L. D., Discharge valve for granular material, 16: 17280
STOVER, C. M., Aluminum oxide humidity element, 16: 16526 (SC-4667(RR))
STOVER, E. R., Pyrolytic graphites, 16: 16760
STRAILE, William E., Millibeam irradiations on mammalian tissue, 16: 16190
STRAUMANIS, M. E., Disintegration of Be, 16: 16373
STROGANOV, E. V., Structure of dihydrate uranyl nitrate, 16: 16391
STROOT, J. P., Hyperon production in π-p collisions, 16: 16979 (NP-11592(Vol.I)(p.385-8))
STROTH, J., Positron polarization in Fermi-type transition, 16: 16059
STRUMANE, R., Preparation of UO_2 single crystals, 16: 16652
STUHLINGER, Ernst, Space missions for ion propulsion, 16: 17324
STURLEY, George William, Improvements in reactor pressure vessels, 16: 17260
SUGIMOTO, Daiichiro, Evolution of Population II stars, 16: 16915
SULLIVAN, John J., Lattice vibrations of zincblende structure crystals, 16: 16804 (AFOSR-2300)
SUNDERMAN, D. N., Wear in large diesel engines, 16: 16062
SUPEK, Z., Irradiation of brain in normal rats, 16: 16273
SUTHERLAND, J. D., Analysis of perforated beams in bending, 16: 16477 (TIM-390)
SUVOROV, N. N., Radioprotective effect in combined preparations, 16: 16296
SUYDAM, B. R., Stability of a plasma Torus, 16: 17194
SWAIN, C. G., Mechanism of Cannizzaro reaction, 16: 16087
SWAINBANK, I. G., Isotopic geochemistry, 16: 16577 (TID-14861(Vols.I and II))
SWAN, G. A., Free-radical arylation induced by γ radiation, 16: 16436
SWEET, William H., Neutron therapy of operatively exposed gliomas, 16: 16250
SWIFT, J. D., Electron energy distribution functions, 16: 16553
SWIFT, L. M., Pressure measurements on structures, 16: 16482 (WT-740)
SWINDEMAN, R. W., Strain-fatigue properties of Inconel, 16: 16728 (ORNL-3250(Pt.I))
SWINDEMAN, R. W., Strain-fatigue properties of Inconel, 16: 16729 (ORNL-3250(Pt.II))
SYMMONS, H. F., Splitting of Gd sulfate octohydrate, 16: 16384
SYMONS, M. C. R., Radicals in irradiated formates and oxalates, 16: 16435
SZEPTYCKA, M., Hyperon production in π-p collisions, 16: 16979 (NP-11592(Vol.I)(p.385-8))
SZIKLA, G., Histological changes following cerebral implantation of gamma isotopes, 16: 16251
SZIKLA, G., Therapeutic use of radioisotopes, 16: 16245

T

TACHIS, A. M., Diffusion of fission gases in UO_2, 16: 16650 (EURAEC-194(App.7))
TACONIS, K. W., Lambda curves of He-3–He-4 mixtures, 16: 16865
TADMOR, J., Isotopic exchange in gas chromatography, 16: 16371
TAFFARA, L., Dispersion relations and stability conditions, 16: 17023
TAKABAYASI, T., New isobasic spin group, 16: 16990 (NP-11592(Vol.I)(p.503-6))
TAKAHASHI, Atsushi, Application of dispersion to K^+-p scattering, 16: 17047
TAKANO, Yoshiro, Structure of space-time. II., 16: 16876
TAKEMIYA, Toshinori, Deuteron elastically scattered by nuclei, 16: 17130
TAKETANI, Hiroshi, Coincidence analyzer, 16: 16547
TALAIRACH, J., Histological changes following cerebral implantation of gamma isotopes, 16: 16251
TALAIRACH, Jean, Therapeutic use of radioisotopes, 16: 16245
TALBOT, J., Penetration of sulfur into iron, 16: 16051
TALBOT, Jean, Structure of stainless steel of 18/8 type, 16: 16739
TALLINI, B., Pion production by protons in hydrogen, 16: 16984 (NP-11592(Vol.I)(p.433-47))
TAMERS, M., Measuring low level tritium, 16: 16097
TAMOR, Stephen, Ionization in cesium discharges, 16: 16856
TAMURA, Taro, Scattering of nucleons by nuclei, 16: 17101
TAMURA, Taro, $2^+ \rightarrow 2^+$ transitions in even nuclei, 16: 17081
TANAKA, E., Whole-body counters at Japan NIRS, 16: 16143
TANAKA, Hiromi, Deuteron elastically scattered by nuclei, 16: 17130
TANAKA, Sho, Quantum field theory with indefinite metric, 16: 17046
TANAKA, Yasuo, Origin of planetary nebulae, 16: 16914
TANANEV, I. V., Plutonium fluorides, 16: 16392
TAPPEL, A. L., Radiosensitivities of fat-soluble vitamins, 16: 16623
TAYLOR, A. E., Elastic and inelastic p-p scattering, 16: 16981 (NP-11592(Vol.I)(p.397-406))
TAYLOR, B. T., Tritium of atmospheric methane, 16: 16079
TAYLOR, J. G. V., Decay of Hg-203, 16: 17075
TAYLOR, John Welsh, Improvements in nuclear reactors, 16: 17249
TAYLOR, R., Electron-proton scattering, 16: 16942 (NP-11592(Vol.I)(p.139-40))
TAYLOR, R. E., Prog. rpt. on refractory materials, 16: 16733 (WADD-TR-60-581(Pt.II))
TAZZARI, S., Photoproduction of π^+ mesons in H_2, 16: 16928 (NP-11592(Vol.I)(p.21-4))
TEE, P. A. H., Reactivity of reactor graphite and other carbons, 16: 16338 (NPCC/MWP(G) P180)
TELEGDI, V. L., Method for determining proton polarization, 16: 16965 (NP-11592(Vol.I)(p.295-9))
TEPLOV, I. B., Alpha angular distributions from $Li^7(p,\alpha)He^4$, 16: 17141
TEPLOVA, Ya. A., Alpha angular distributions from $Li^7(p,\alpha)He^4$, 16: 17141
TEPPER, F., Determination of C in Na, 16: 16690 (TID-7626(Pt.I)(p.146-9))
THARP, A. G., Structure of La-family silicides, 16: 16378
THATCHER, L. L., Tritium studies in Geological Survey, 16: 16081
THOMAS, A. O., Absolute counting of Ru-103, 16: 16421
THOMAS, C. C., Jr., Hydrogenous shield materials, 16: 17221 (DC-52-5-41)
THOMAS, C. M., Hand exposure time, 16: 16616
THOMAS, David Gersey Arnold, Precipitation chambers, 16: 16566
THOMAS, R. N., Aerodynamic phenomena in stellar atmospheres, 16: 16903
THOMPSON, P. E., Mutability in Drosophila, 16: 16203
THOMSON, C., Alkyl radicals in γ-irradiated alkyl halides, 16: 16438
THOMSON, George, Improvements relating to thermonuclear reactors, 16: 17213
THOMSON, W. B., Metal screen, folded, water moderated air cycle reactor, 16: 17288 (DC-52-4-37)
THOR, Rena, Cosmic ray produced P-32, P-33, Be-7, and S-35, 16: 16589
THORNDIKE, E. H., Depolarization of a beam of polarized protons, 16: 17167
THORNTON, H. R., Process for applying ceramic and cermet coatings, 16: 16641 (ARL-59)
THOULESS, D. J., Rotational states of nuclei, 16: 17102
TIBELL, G., Decay rate of negative muons, 16: 16944 (NP-11592(Vol.I)(p.143-5))
TILBURY, P. D., Electric conductivity of Be, 16: 16749
TIMEROV, R. Kh., Theory of nuclear resonance in paramagnetic media, 16: 16887
TIMUSHEV, G. F., Proton inelastic scattering on Ca-40 and Mn-55, 16: 17146
TIPTON, Clyde R., Jr., Prog. rpt. on civilian applications, 16: 17229 (BMI-1565(Del.))
TKACHENKO, E. V., Sorption of isotopes by MnO_2, 16: 16389

TO, Ying-seb, Proton-proton elastic scattering at 2.8 Bev, 16: 17050

TOBIAS, C., Glycogen in rat brain after irradiation, 16: 16275

TOBIAS, Cornelius A., Biological effects of heavy radiation particles, 16: 16242

TODD, D. K., Canal seepage measurements with T, 16: 16082

TODES, O. M., Properties of radioactive substance sorption, 16: 16440

TODISCO, S., Concentration of Ar-41 in pool reactor, 16: 17312

TOMILIN, I. A., Activity of antimony in alpha iron, 16: 16053

TOOHIG, T., Three-pion resonances in π^+-D reactions, 16: 16962 (NP-11592(Vol.I)(p.277-82))

TORELLI, G., Annihilation in flight of positrons, 16: 16946 (NP-11592 (Vol.I)(p.151-3))

TOURNOUX, P., Therapeutic use of radioisotopes, 16: 16245

TREACY, E. B., Hfs in rotational spectrum of HDO, 16: 16355

TREHERNE, J. E., Radioisotopes and insect nervous system, 16: 16117

TRENT, C. H., Nuclear rocket for space propulsion, 16: 17325

TRESHOW, Michael, Control of boiling water reactor, 16: 17305

TREVALIAN, P. A., Radicals in irradiated formates and oxalates, 16: 16435

TROTTER, J., Soft x-ray emission spectra from Cs_3Au, 16: 16867

TROUVE, C., Control of concentration in gaseous diffusion plant, 16: 16626 (CEA-2010)

TSU, T. C., Straight-line flight to Mars, 16: 17326

TSUCHIMOTO, M., Isotopic exchange of gallium, 16: 16363

TSUKUDA, Masahiro, Gridded ionization chamber, 16: 16541

TSUNETO, Toshihiko, Quantization of flux in superconductors, 16: 16877

TSYGANOV, E. N., Proton-proton elastic scattering at 2.8 Bev, 16: 17050

TSYTKO, S. P., Resonances in $Si^{28}(p,\gamma)P^{29}$ reaction, 16: 17145

TSYTOVICH, V. N., Mass and energy losses of charged particles, 16: 16885

TUAN, S. F., Threshold mass numerologies, 16: 17028

TUCKER, T., Fireball hydrodynamics, 16: 17292 (FXM-428)

TURKOT, F., Inelastic p-p scattering, 16: 16983 (NP-11592(Vol.I)(p.419-25))

TURLAY, R., Neutral processes in π^--p interaction, 16: 16932 (NP-11592(Vol.I)(p.45-55))

TURNER, R. B., Neutron spectra in cylinder of hot moderator, 16: 17233 (CRRP-985-D)

TURNER, Roy, Radiation-resistant lubricants, 16: 16797

TYS, J. (Ya.), Interaction of N-14 and Ne-20 with C, Al, Cu, and Ta, 16: 17153

U

UBEROI, Mahinder S., Magnetohydrodynamics, 16: 16854

UEHLING, Edwin A., NQR of As-75 in $Na_2HAsO_4 \cdot 7H_2O$, 16: 16360

UEHLING, Edwin A., Nuclear magnetic resonance of As and Sb, 16: 16361

UJHELYI, Csaba, Process of preparation of actinium, 16: 16460

ULENBUSCH, J., Magnetohydrodynamic theory of lubrication, 16: 16855

UMEZAWA, Hiroomi, Gauge transformation for meson fields, 16: 17018

UMEZAWA, Hiroomi, Strangeness violating weak interactions, 16: 17048

UNDERHILL, A. B., Turbulence in stellar atmospheres, 16: 16904

UREY, Harold C., Information of solar system and nucleosynthesis, 16: 16901

URINSON, R. M., Properties of blood during Rn therapy, 16: 16290

Uy, Phu Sy
see *Phu Sy Uy*

V

VACEK, A., Metabolic reactivity of irradiated organism, 16: 16284

VAKSELJ, Marko, Allowed l-forbidden transitions, 16: 17122

VALATIN, J. G., Rotational states of nuclei, 16: 17102

VALENTIN, J., Decay of Hf-173, 16: 17110

VALENTIN, J., Energy levels of Lu-172, 16: 17111

VALENTIN, Jacques, Auger electrons of Lu, 16: 16823

VALIEV, K. A., Theory of nuclear resonance in paramagnetic media, 16: 16887

VALIN, Jean, Influence of PP⁺ junction on particle detector, 16: 16546

VALLADAS, G., Neutral processes in π^--p interaction, 16: 16932 (NP-11592(Vol.I)(p.45-55))

VALLADAS, Georges, Pion-nucleon interactions, 16: 16989 (NP-11592 (Vol.I)(p.467-83))

VALPREDA, G., Bronchopulmonary disease during radiotherapeutic treatment, 16: 16227

VAL'TER, A. K., Resonances in $Si^{28}(p,\gamma)P^{29}$ reaction, 16: 17145

VALYI-NAGY, T., Toxic effects of x-ray on *E. coli*, 16: 16297

VAN BAERLE, Frederic Charles Gerard, Nuclear reactor simulator, 16: 17255

VAN DER WERFF, J. Th., Gamma-encephalography with Bi-206, 16: 16252

VAN DILLA, M. A., Human counters using scintillators, 16: 16136

VAN KRUGTEN, H., Beta transition in Tl-200, 16: 17113

VAN LIERDE, W., Preparation of UO_2 single crystals, 16: 16652

VAN NOOIJEN, B., Beta transition in Tl-200, 16: 17113

VAN NORMAN, John D., Controlled potential coulometry, 16: 16310

VAN OEVELEN, Emile, Improvements in manufacture of isotopes, 16: 16447

VAN-PEI, Peripheral interactions of fast particles, 16: 17016

VAN TUYL, H. H., Recovery of Sr from Purex wastes, 16: 17333 (HW-69534)

VASIL'EV, S. S., Proton inelastic scattering on Ca-40 and Mn-55, 16: 17146

VASIL'EV, S. S., Radioactive nuclei in region of filled $1f_{7/2}$ shell, 16: 17148

VDOVENKO, V. M., Structure of dihydrate uranyl nitrate, 16: 16391

VDOVENKO, V. M., Uranyl nitrate extraction by diethyl ether, 16: 16462

VEALL, N., Clinical whole-body counting, 16: 16155

VEDRENNE, Gilbert, Reaction $Si^{28}(n,\alpha)Mg^{25}$ at 14.6 Mev, 16: 17076

VEKSLER, V. I., Interaction of Rb and Cs ions with Mo, 16: 16881

VELJKOVIC, S. R., Szilard-Chalmers reaction in potassium permanganate, 16: 16423

VENABLE, Douglas, High current electron accelerator, 16: 17168

VENCHIARUTTI, D., Pion production by π^+ on protons, 16: 16929 (NP-11592(Vol.I)(p.25-6))

VERNIER, Philippe, Velocity distribution in water stream, 16: 16510

VESTAL, M., On-stream tracer techniques, 16: 16069

VIADO, G. B., Insect-control investigations, 16: 16131

VIALE, G., Pion production by π^+, 16: 16930 (NP-11592(Vol.I)(p.27-35))

VIGIER, J. P., New isobaric spin group, 16: 16990 (NP-11592(Vol.I)(p.503-6))

VINCENT, Germaine, Apparatus for ionized gas, 16: 17217

VINCENT, L. M., Corrosion by UF_6. II., 16: 16695

VINH MAU, R., On nucleon-nucleon potential, 16: 16972 (NP-11592 (Vol.I)(p.347-9))

VINOGRADOVA, N. I., Separation of Zn, Cd, Cu, Pb, Bi, and Ag, 16: 16463

VODOP'YANOV, L. K., Irradiation of dielectrics in reactors, 16: 16785

VOLKOV, V. V., Interaction of N-14 and Ne-20 with C, Al, Cu, and Ta, 16: 17153

VOLKOVA, M. A., Radioactive Cs for gamma therapy, 16: 16168

VOLPICELLI, Richard, Broad-line NMR spectrometer, 16: 16525 (NP-11497)

VON BORSTEL, R. C., Control of populations, 16: 16129

VON BUTTLAR, H., Geiger counter for tritium, 16: 16099

VON ENGEL, A., Dissociation and ionization of H, 16: 16871

VOTRUBA, F. M., Production of electron pairs by pions, 16: 16935 (NP-11592(Vol.I)(p.79-83))

VRABEC, Radko, Radiation cancer after hemangioma treatment, 16: 16236

VRETAS, T., Prog. rpt. on producibility of Ti–Al–Zr alloys, 16: 16706 (AD-264434)

VUL, B. M., Nature of the long spark, 16: 17182 (FTD-TT-61-149)

W

WAABEN, S., Magnet power servo system for proton synchrotron, 16: 17157 (PPAD-442D)

WACK, Bernard, Measurement of soil humidity, 16: 16620

WACKMAN, P. H., A three-body model of Li-6, 16: 17079

WADA, J. Y., Plasma negative resistance amplifier, 16: 17189

WADA, Morihiro, Gauge transformation for meson fields, 16: 17018

WAGGONER, J. A., Lunar surface composition analysis, 16: 16532

WAGNER, F. E., 84-Kev level in Yb-170, 16: 17135

WAHLIN, L., Particle identification system, 16: 16635

WAKEFIELD, C., Radiation-conditioned behavior, 16: 16266

WAKITA, Hiteshi, Measurement in quantum mechanics. II., 16: 16875
WALDER, H. A. D., Gamma-encephalography with Bi-206, 16: 16252
WALKER, A., Basic beryllium nitrate, 16: 16380
WALKER, B. L., Response of rabbits to nephrotoxic serum, 16: 16195
WALKER, T. G., Elastic and inelastic p-p scattering, 16: 16981 (NP-11592(Vol.I)(p.397-406))
WALKER, W. D., Inelastic hyperon production with π^-, 16: 16977 (NP-11592(Vol.I)(p.371-4))
WALKER, W. D., On π-π interactions, 16: 16958 (NP-11592(Vol.I)(p.249-56))
WALLACE, G. W., Jr., Determination of niobium, 16: 16315
WALLACE, W. E., Compounds between cobalt and lanthanide elements, 16: 16742
WALLACE, W. E., Magnetic characteristics of hydrogenated Ho, 16: 16840
WALLACE, W. E., Phases in lanthanon–manganese systems, 16: 16744
WALLERSTEIN, George, Abundances in A stars. I., 16: 16896
WALLIS, G. B., Flooding velocities for air and water in vertical tubes, 16: 16498 (AEEW-R-123)
WALSH, D. K., Bibliography of JPL publications, July 1960–June 1961, 16: 17319 (NP-11568)
WALTER, F. J., Nuclear orientation experiments, 16: 16061
WAMPLER, J. M., Isotopic geochemistry, 16: 16577 (TID-14861(Vols.I and II))
WANG, Fu-Chiang, Concentration of actinite, 16: 16397
WANG, James Y. N., Mercury corrosion of Ti alloys, 16: 16683 (TID-7626(Pt.I)(p.107-8))
WAPSTRA, A. H., Beta transition in Tl-200, 16: 17113
WAPSTRA, A. H., New relative nuclidic masses, 16: 17086
WAPSTRA, A. H., 1961 nuclidic mass table, 16: 17087
WARNECKE, Robert R., Apparatus for ionized gas, 16: 17217
WARNER, L. B., Separated isotopes by cathodic sputtering, 16: 16433
WARREN, C. G., Extraction of Y and La, 16: 16366
WARREN, F. L., Astronautics information, Vol. 3, No. 3, 16: 17317 (NP-11476)
WATANABE, H., Whole-body counters at Japan NIRS, 16: 16143
WATSON, C. D., Cost of processing stainless steel-jacketed UO_2 fuel, 16: 16457 (ORNL-3227)
WATSON, R. E., Nuclear magnetic moments of rare-earth ions, 16: 16831
WATT, D. E., Absolute counting of Ru-103, 16: 16421
WAUK, M. T., Excitation migration in organic crystals, 16: 16379
WAY, K., Nuclear data tables. IV., 16: 17154
WEBB, J. W., Measurement of gas flow, 16: 16073
WEBER, E. H., Radiation effects on CdS single crystals, 16: 16793
WEHMEYER, D. B., Theoretical analysis of SSCR. I., 16: 17227 (BAW-1230(Pt.I))
WEIDENBAUM, B., Prog. rpt. on UO_2 program, 16: 17296 (GEAP-3771-2)
WEIDHAAS, D. E., Metabolism of insecticides in animals, 16: 16115
WEIDHAAS, D. E., Radiation in insect control, 16: 16127
WEIL, Louis, Recovery of radioinduced faults in Fe, 16: 16783
WEILAND, Raymond L., Whole-body-counter data processing, 16: 16154
WEINSTEIN, D., Prog. rpt. on Zr alloys, 16: 16674 (ARF-2198-24)
WEIR, R. N., High background radiation, 16: 16173
WEISS, Jacques, Process for production of atomic energy, 16: 17212
WEISS, Volker, Low cycle fatigue, 16: 16767
WEISZ, Michel, Segregation of impurities in Be, 16: 16740
WELGE, Karl Heinz, Centrifuges for separation of isotopes, 16: 16630
WENDT, Gerhard, Directional correlations in Pt-192, 16: 17116
WENSEL, A., Measurement of environmental radiation, 16: 16614
WENTZEL, Donat G., Oscillations of self-gravitating fluid, 16: 16900
WENZEL, W., K^+-nucleon total and differential cross-sections, 16: 16957 (NP-11592(Vol.I)(p.247))
WERBOFF, Jack, Effects of prenatal radiation on rat, 16: 16221
WERNER, E., Enrichment of D and T, 16: 16083
WERNER, Z., Potassium salts prospecting, 16: 16044
WERZ, Guenther, Alteration of morphological processes by uv radiation, 16: 16239
WEST, E., On π-π interactions, 16: 16958 (NP-11592(Vol.I)(p.249-56))
WESTBROOK, H. L., Scintillation detection of tritium, 16: 16091
WESTON, V. H., Gravity and acoustical waves, 16: 16580
WESTON, V. H., Pulse produced by large explosion. II., 16: 16579
WESTWATER, J. W., Film boiling on a horizontal plate, 16: 16508
WETHERELL, A. M., Elastic and inelastic p-p scattering, 16: 16981 (NP-11592(Vol.I)(p.397-406))
WHETSTONE, A., Nanosecond coincidence circuit, 16: 16557
WHIFFEN, D. H., Irradiated crystalline sodium formate, 16: 16430
WHIFFEN, D. H., Spin resonance spectrum of $CH_3CH(CO_2H)$, 16: 16429
WHIPPLE, E. C., Jr., Instrumentation of ionosphere measurements satellite, 16: 17316 (NASA-TN-D-414)
WHITE, A. M., Ductility of Zy-clad fuel elements, 16: 16723 (NMI-7211)
WHITE, J. C., Alkali metal analytical program at ORNL, 16: 16686 (TID-7626(Pt.I)(p.128-9))
WHITE, Millege M., Profiling of fluid injection wells, 16: 16590
WHITE, Wilfrid F., Erythropoietic factor purification, 16: 16164
WHITEHEAD, J. K., Determination of amino acids, 16: 16089
WHITNEY, C. A., External layers of intrinsic variable stars, 16: 16905
WIEDEMANN, W. H., Mössbauer effect in Sn-119, 16: 17138
WIEGAND, David E., Hydraulic servo, 16: 16493
WIESEHAHN, W. J., Beta transition in Tl-200, 16: 17113
WILDERMUTH, Karl, Influence of nucleons on nuclear structure, 16: 17120
WILGAIN, S., Air radioactivity in the Antarctic, 16: 16042
WILKINS, R. G., Properties of Pa(V) in H_2SO_4, 16: 16365
WILKINSON, C. A., Antiproton annihilation into two charged pions, 16: 16961 (NP-11592(Vol.I)(p.269-75))
WILKINSON, M. K., Magnetic ordering in thulium, 16: 16835
WILKINSON, M. K., Neutron diffraction of Pd and Fe group alloys, 16: 16839
WILKS, R. S., Crystal habit of UO_2, 16: 16759
WILLIAMS, David William, Fuel elements for reactors, 16: 17265
WILLIAMS, J., Sintering behavior in PuO_2–UO_2 system, 16: 16753
WILLIAMS, John A., Abundances in A stars. I., 16: 16896
WILLIS, W. J., K^0 interactions, 16: 16955 (NP-11592(Vol.I)(p.235-9))
WILLIS, W. J., K^0 decays, 16: 16956 (NP-11592(Vol.I)(p.241-5))
WILSDORF, H. G. F., Dislocation behavior in irradiated stainless steel, 16: 16790
WILSON, E. J., Leaks in sealed components, 16: 16071
WILSON, George Raymond Briscoe, Apparatus for assessment of film badges, 16: 16564
WILSON, H. W., Half life of Rb-87, 16: 16041
WILSON, R., Electron-proton scattering, 16: 16942 (NP-11592(Vol.I)(p.139-40))
WILSON, Robert R., Electric structure of nucleons, 16: 16996 (NP-11592(Vol.II)(p.21-31))
WINCIERZ, P., Constitution of Zr–Nb alloys, 16: 16719 (EURAEC-137)
WINCKLER, J. R., Solar influences on radiation in space, 16: 16186
WINZELER, H., Elastic scattering of protons on H_2, 16: 16939 (NP-11592(Vol.I)(p.111-15))
WITHNELL, R., Proportional counter, 16: 16543
WITTEMAN, Willard G., Dissociation pressure of UC_2, 16: 16352
WITTKOPF, W. A., Theoretical analysis of SSCR. I., 16: 17227 (BAW-1230(Pt.I))
WOJTOWICZ, B., Radiation effects on CdS single crystals, 16: 16793
WOLF, Herman S., Protection of lethally x-irradiated mice, 16: 16289
WOLF, Robert V., Teletherapy head, 16: 16163
WOLF, S. E., Reaction $\pi^- + p \rightarrow \Lambda^0 + K^0$ at threshold, 16: 16952 (NP-11592(Vol.I)(p.203-7))
WOLFE, L. S., Glycogen in rat brain after irradiation, 16: 16275
WOLLAN, E. O., Magnetic ordering in thulium, 16: 16835
WOLLAN, E. O., Neutron diffraction of Pd and Fe group alloys, 16: 16839
WONG, J., Fabrication of core materials, 16: 16665
WOOD, G. T., Electronic relaxation in Sm^{++} in EuIG, 16: 16832
WOODSUM, H. C., Removal cross sections of C and O_2, 16: 17064 (CNLM-3244)
WOOLCOCK, W. S., Low energy p-n scattering and p-p interactions, 16: 16973 (NP-11592(Vol.I)(p.351-4))
WOOLCOCK, W. S., Parameters of low-energy pion physics, 16: 16987 (NP-11592(Vol.I)(p.459))
WOOLCOCK, W. S., Pion-nucleon phase shifts, 16: 16988 (NP-11592(Vol.I)(p.461))
WOGLES, W. R., Irradiation zymosan administration, 16: 16226
WOOTTON, William Robert, Manufacturing heat exchanger tubes, 16: 16489
WORLEY, Norman George, Improvements in nuclear fuel elements, 16: 17257

WORLEY, Norman George, Improvements in fuel elements, 16: 17258
WORLEY, W. R., Spectral shift control reactor physics, 16: 17286 (BAW-1230(Pt.II))
WORSHAM, H. J., Exponential experiments on D$_2$O–H$_2$O moderated lattices, 16: 17228 (BAW-1233)
WRAY, D., Accident probability due to reactor protective system failure, 16: 16595 (AHSB(S) R-35)
WRIGHT, Byron T., Techniques of magnetic field measurement, 16: 17165
WRIGHT, K. H. R., Tracers in lubrication research, 16: 16063
WRIGHT, W. B., Safeguards for the EBOR critical experiment, 16: 16604 (GA-1100(Suppl.3))
WU, Ta-you, Irreversible processes in ionized gases, 16: 16820

Y

YAGOVOI, P. N., Radiometer for beta-active preparations, 16: 16539
YAKOVENKO, V. M., Theory of transition radiation, 16: 17207
YAMAGATA, T., Photon production in p-p collisions, 16: 16934 (NP-11592(Vol.I)(p.73-7))
YAMAMOTO, Kunio, Absorptive part of scattering amplitude, 16: 17039
YAMAMOTO, Kunio, Redundant poles of S matrix, 16: 17045
YAMAMOTO, S. S., K^0 interactions, 16: 16955 (NP-11592(Vol.I)(p.235-9))
YAMAMOTO, S. S., K^0 decays, 16: 16956 (NP-11592(Vol.I)(p.241-5))
YAMAZAKI, K., "New Tamm-Dancoff" approximation, 16: 16850
YANG, L., Prog. rpt. on carbide cathode studies, 16: 16807 (GA-3093)
YANS, F. M., Cladding and bonding techniques, 16: 16666
YARMONENKO, S. P., Radioprotective effect in combined preparations, 16: 16296
YODA, Eiji, Contamination in reflection electron diffraction, 16: 16841
YOSHIDA, Hiroshi, $2^+ \to 2^+$ transitions in even nuclei, 16: 17081
YOUMANS, Arthur H., Radiation detectors, 16: 16571
YUAN, L. C. L., π-production in p-p collisions, 16: 16933 (NP-11592(Vol.I)(p.57-67))
YUDELOVITCH, M., Effect of radiation on fruit fly eggs, 16: 16123
YULDASHEV, A. A., Proton-proton elastic scattering at 2.8 Bev, 16: 17050
Yee, K. S., Transport properties of dissociating air, 16: 16853
YUR'EV, V. G., Electron mobility in plasma, 16: 17205

Z

ZABETAKIS, M. G., Prog. rpt. on use of liquid hydrogen in bubble chambers, 16: 16610 (TID-15422)
ZABUSKY, Norman J., Magnetic flux diffusion equation, 16: 17198
ZADOFF, L., Theorems in magnetohydrodynamics, 16: 17330
ZAITSEVA, V. P., Plutonyl in aqueous solutions, 16: 16393
ZAKRZEWSKI, J., Hyperfragments from interactions of K$^-$ mesons with emulsion nuclei, 16: 16976 (NP-11592(Vol.I)(p.363-9))
ZAREMBO, Yu. I., Beryllium. Chemical technology and metallurgy, 16: 16771
ZARETSKII, D. F., Excitation of nuclear levels in μ-mesic atoms, 16: 17151
ZASLAVSKII, Yu. S., Operative properties of lubricating oils, 16: 16064
ZELLE, A., Analysis of radioactive solutions, 16: 16306 (PAN-250/XIII)
ZELLMER, Robert W., Cosmic radiation—lab. observations, 16: 16193
ZEMAN, W., Histochemical studies on mouse brains, 16: 16276
ZENGER, J. H., Lunar surface composition analysis, 16: 16532
ZHELEZNYAKOV, V. V., Instability of magnetoactive plasma. III., 16: 17184 (JPRS-12990(p.54-75))
ZHEREBCHENKO, P. G., Radioprotective effect in combined preparations, 16: 16296
ZHEREKHOV, V. G., Determination of MsTh$_1$, 16: 16323
ZIGEL', F. Yu., Nuclear explosion over the Taiga, 16: 16032 (JPRS-13480)
ZIPF, T., K$^+$-nucleon total and differential cross-sections, 16: 16957 (NP-11592(Vol.I)(p.247))
ZLOBIN, V. S., Adsorption of Y and Zr by Zr phosphates, 16: 16390
ZSCHAUER, K. H., Additive coloring of Sr fluoride, 16: 16860
ZUBER, A., Potassium salts prospecting, 16: 16044
ZUMWALT, L. R., Vapor transport of U from UC$_2$–C compacts, 16: 16721 (GAMD-1233)
ZUPPINGER, Adolf, Calcium assimilation in bone, 16: 16232
ZUTSHI, P. K., Cosmic ray produced P-32, P-33, Be-7, and S-35, 16: 16589
ZVEREVA, M. N., Separation of Zn, Cd, Cu, Pb, Bi, and Ag, 16: 16463
ZWICKER, U., Constitution of Zr–Nb alloys, 16: 16719 (EURAEC-137)
ZWINGENBERGER, J., π-N forward scattering, 16: 16991 (NP-11592(Vol.I)(p.485-6))

SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries. A more complete description of the patterns and style of indexing used is included in the introductions to the subject index cumulations that are issued quarterly.

As an aid to the users of this index, references to report numbers, where appropriate, are included after the abstract number of the citation.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number in that volume. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. Published literature (journal article or book) is identifiable by the absence of a report number.

A

ACCELERATORS
- beam transport system design and construction, 16: 17160
- description of single cavity high-current electron, 16: 17168
- shielding, calculation methods for, 16: 17161
- uses as radiation sources for nondestructive testing, 16: 17162

ACETIC ACID, (ETHYLENEDIAMINE)TETRA- COMPLEXES
- with gallium in water, isotope exchange of gallium, 16: 16363

ACETIC ACID, (*N*-HYDROXYETHYLETHYLENEDIAMINE)TRI- COMPLEXES
- with gallium in water, isotope exchange of gallium, 16: 16363

ACETIC ACID, TRIPHENYLETHYL ESTERS
- analysis for carbon-14 by liquid scintillation, 16: 16091

ACETYLENE
- electronic energy, 16: 16357

ACRYLAMIDE
- radioinduced graft polymerization on synthetic condensation polymers, 16: 16448(P)

ACTINIUM
- separation from uranium leach residue, 16: 16460

ACTIVATION ANALYSIS
- formula for measuring self-shielding effect in irradiated metals, 16: 16415
- use in analysis of high-purity silicon production processes, 16: 16075

ADRENALINE
- protective effects against radiation injuries and nitrogen mustard in *E. coli*, 16: 16297

AERODYNAMICS
- of stellar atmospheres, 16: 16903

AGE ESTIMATION
- survey of isotopic, 16: 16577 (TID-14861(Vols.I&II))

AGING
- biological factors, 16: 16228

AIR
- flow in vertical tubes, flooding velocities for countercurrent annular, 16: 16498 (AEEW-R-123)
- transport properties at high temperatures, collision integrals and potential energy functions, 16: 16853

AIRCRAFT
- materials, properties of elastomers as, 16: 16302 (ASD-TR-61-234)

ALANINE
- determination in protein hydrolyzates using carbon-14 or tritium labeled 1-fluoro-2,4-dinitrobenzene, 16: 16089
- radiolysis at 100 to 200°K, 2-carboxyethyl electron spin resonance spectrum in gamma, 16: 16429

ALANINE, PHENYL-
- determination in protein hydrolyzates using carbon-14 or tritium labeled 1-fluoro-2,4-dinitrobenzene, 16: 16089

ALBUMINS
- labeled with iodine-131, as tracer in studies of protein metabolism, 16: 16158

ALCOHOLS
- ionization potentials, effects of substitution, 16: 16406 (NP-11495)

ALGAE
- radiation effects on species-specific morphological processes in Acetabularia, 16: 16239
- radiation effects on dual-nucleated transplants in Acetabularia, 16: 16240

ALKALI METALS
- analysis for oxygen, methods development, 16: 16687 (TID-7626 (Pt.I)(p.130-40))

ALKALI METALS (LIQUID)
- corrosive effects, conference, 16: 16676 (TID-7626(Pt.I))

ALKENES
- radioinduced polymerization of conjugated di-, 16: 16450(P)

ALKYL HALIDES
- radiolysis, electron spin resonance spectra of alkyl radicals in gamma, 16: 16438

ALKYL IODIDES
- radiolysis in hydrocarbon solvent, 16: 16339(R) (TID-15369)

ALLOYS
- bibliography on high-strength, 16: 16727 (NP-11553)

ALPHA PARTICLES
- detection and measurement by alpha spectrometry, 16: 16552
- effects on electrical activity of nerves, 16: 16197
- effects on eyes in Macaca mulatta primates at 910 Mev, relative biological, 16: 16193
- electron capture in hydrogen, cross sections for, 16: 17035
- neurological effects on glycogen appearance in rat brains, 16: 16275
- pathological effects in brain, 16: 16243
- reactions (α,n) with boron-11, angular distributions from, 16: 17119
- reactions with rubidium, yttrium-86 isomer production in, 16: 17115
- role in lithium-6 three-body model, 16: 17079
- scattering of 42-Mev, magnetic analysis, 16: 16542

ALPHA SPECTROMETERS
- design and performance of magnetic, 16: 16542
- performance for obtaining spectra, 16: 16552

ALUMINUM
- determination in uranium compounds, spectrographic, 16: 16304 (CNEN-96)
- determination in uranium, volumetric, 16: 16307 (PG-Report-293)
- development and properties for fuel element cladding, review, 16: 16661

- production, current efficiency of electrolytic cells for, 16: 16072
- reactions with neon-20 and nitrogen-14 ions, nitrogen-17 production, 16: 17153
- solubility in plutonium, 16: 16750
- structural properties and uses in reactors, survey, 16: 16036

ALUMINUM ALLOYS
- creep-rupture studies, 16: 17229(R) (BMI-1565(Del.))
- fatigue under strain-controlled low-cycle conditions, 16: 16767
- radioinduced overaging in, 16: 16774 (ARL-132)
- structural properties and uses in reactors, survey, 16: 16036

ALUMINUM–BERYLLIUM–MAGNESIUM ALLOYS
- cavitation and creep properties at 20 to 500°C, 16: 16762

ALUMINUM–CHROMIUM–IRON ALLOYS
- properties as cladding material, alloying effects of niobium and titanium on, 16: 17276(P)

ALUMINUM–COPPER ALLOYS
- copper distributions in, 16: 16052

ALUMINUM DEUTERIDES
- spectra, analysis and observation of 2187Å band, 16: 16383

ALUMINUM FILMS
- fission-product effects in, 16: 16787

ALUMINUM–IRON COUPLES
- thermal resistance of contact, 16: 16476(R) (NYO-9457)

ALUMINUM ISOTOPES Al-26
- energy levels, 16: 17103

ALUMINUM ISOTOPES Al-27
- gamma reactions (γ,p) energy distribution, 16: 17137
- gamma spectra, de-excitation of 3 Mev doublet in, 16: 17129

ALUMINUM OXIDE COATINGS
- deposition on substrates by flame spraying, 16: 16641 (ARL-59)

ALUMINUM OXIDES
- sorptive properties for fission products, 16: 16459
- use as humidity sensing element, 16: 16526 (SC-4667(RR))

ALUMINUM–PLUTONIUM ALLOYS
- phase diagram revisions, 16: 16750

ALUMINUM POWDERS
- fabrication and properties of sintered, 16: 17299(R) (SRO-66)
- welding of sintered, magnetic force techniques for, 16: 16699 (HW-72379)

ALUMINUM SULFATES
- analysis for molybdenum and tin by solvent extraction with 8-quinolinol, spectrophotometric, 16: 16314

ALUMINUM–TIN–TITANIUM–ZIRCONIUM ALLOYS
- corrosion by mercury at 700°F, 16: 16683 (TID-7626(Pt.I)(p.107-8))
- production and properties of sheet, 16: 16706(R) (AD-264434)

ALUMINUM–TITANIUM–VANADIUM ALLOYS
- corrosion by mercury at 700°F, 16: 16683 (TID-7626(Pt.I)(p.107-8))

ALUMINUM–TITANIUM–ZIRCONIUM ALLOYS
- corrosion by mercury at 700°F, 16: 16683 (TID-7626(Pt.I)(p.107-8))
- production and properties of sheet, 16: 16706(R) (AD-264434)

ALUMINUM–ZINC ALLOYS
- zone formation in, factors affecting, 16: 16766

AMINE COMPLEXES
- decomposition effects of triethylenetetra-, on endogenic formation of carbon monoxide during radiation sickness, 16: 16292

AMINO ACIDS
- measurement of radioinduced radicals in solutions, 16: 16434

AMMONIUM COMPOUNDS, QUATERNARY
- solvent properties for niobium-pyrogallol complexes, 16: 16327
- solvent properties for pyrogallol–tantalum complexes, 16: 16328

AMMONIUM FLUORIDE–AMMONIUM NITRATE SYSTEMS
- corrosive effects on type 309SCb stainless steel, 16: 16464

AMMONIUM FLUORIDES
- corrosive effects on type 309SCb stainless steel, 16: 16464

AMPLIFIERS
- design and performance of low noise, for gridded ionization chamber, 16: 16541
- radio, effects of input on enhancement of four-level RASER, 16: 16517 (AFOSR-1794(p.15-44))
- theory of plasma negative resistance type, 16: 17189

ANIMAL CELLS
- radiation effects, indirect, reaction mechanisms, 16: 16230
- radiation effects on HeLa, gamma, heavy ion, and x, 16: 16189
- radiation energy distribution, measurement, 16: 16229
- radiosensitivity, 16: 16224

ANIMAL METABOLISM
- insecticides, mechanism of organophosphate, 16: 16113

ANIMALS
- radiation effects on behavior, classical conditioning facilities and statistical analysis methods for studying, 16: 16265

ANISOLE
- exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344

ANOXIA
- radiosensitivity effects in rats, 16: 16234

ANP REACTORS
- design of water-moderated air-cycle type with folded-metal-screen fuel elements, 16: 17288 (DC-52-4-37)
- hydrodynamic analysis of Fireball, 16: 17292 (FXM-428)

ANTARCTICA
- fall-out monitoring between 60°N and 70°S in 1958, 16: 16042

ANTHRACENE
- exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344

ANTIBIOTICS
- sensitivity of intestinal microflora to, strontium-90 carrier effects on seasonal fluctuations in, 16: 16210

ANTIBODIES
- formation in spleen, reaction mechanisms, 16: 16196

ANTIFERROMAGNETIC MATERIALS
- thermodynamic properties, study of spin ½ atomic chains, 16: 16802 (AFOSR-1934)

ANTIMONY
- diffusion in copper single crystals at 540 to 650°C, 16: 16045
- distribution between liquid lead and liquid or solid iron, 16: 16053

ANTIMONY CHLORIDES
- nuclear magnetic resonance of antimony-121 in liquid, at room temperature, 16: 16361

ANTIMONY–INDIUM ALLOYS
- radiation effects of thermal neutrons, radiation doping, 16: 16056

ANTIMONY–IRON ALLOYS
- thermodynamic activity of antimony in α-iron, 16: 16053

ANTIMONY ISOTOPES Sb-121
- nuclear magnetic resonance in antimony chloride at room temperature, 16: 16361

ANTIMONY ISOTOPES Sb-124
- determination in man, whole-body counting, 16: 16162

ANTIMONY OXIDES
- additive effects on properties of elastomers, 16: 16707(R) (AD-265319)

ANTIMONY–SILVER–TELLURIUM SYSTEMS
- thermoelectric properties, 16: 16708(R) (AD-266128)

ANTIMONY–TELLURIUM SYSTEMS
- thermoelectric properties, 16: 16708(R) (AD-266128)

ANTINUCLEONS
- interactions with nucleons, core phenomena in, 16: 17044

ANTIPROTONS
- annihilation at rest, charged meson (π) formation, 16: 16961 (NP-11592(Vol.I)(p.269-75))
- interactions with protons, cross sections at 0.58 to 5.3 Bev, 16: 16963 (NP-11592(Vol.I)(p.283-6))
- scattering by nuclear emulsions at 0 to 250 Mev, cross sections, 16: 16922 (AD-261903)

APPALACHIAN MOUNTAINS (NORTH AMERICA)
- metamorphic history, 16: 16577 (TID-14861(Vols.I&II))

ARCO CHEMICAL PLANT
- criticality incident, 16: 16464

ARGININE
- determination in protein hydrolyzates using carbon-14 or tritium labeled 1-fluoro-2,4-dinitrobenzene, 16: 16089

ARGON
- analysis for nitrogen traces, spectrographic, 16: 16570(P)
- corresponding states theory, 16: 16374
- detection in minerals and rocks, 16: 16577 (TID-14861(Vols.I&II))
- determination in geothermal bores, fumaroles, and pools in New Zealand, mass spectrometric, 16: 16581

electron transfer collisions near adiabatic conditions with gaseous atoms, ions, and molecules, 16: 16868
plasma generation and acceleration by stationary field induction coil, 16: 17321
pressure drop in water mixture, effects of test-section geometry, 16: 17291(R) (EURAEC-222)
sintering effects on plutonium oxide–uranium oxide powder phase equilibria, 16: 16753

ARGON–HYDROGEN SYSTEMS
electron transfer collisions near adiabatic conditions, 16: 16868

ARGON IONS
electron transfer collisions near adiabatic conditions with hydrogen, 16: 16868
interactions with beryllium and molybdenum, secondary ion emission, 16: 16880

ARGON ISOTOPES Ar-36
ratio with argon-40 in geothermal bores, fumaroles, and pools in New Zealand, 16: 16581

ARGON ISOTOPES Ar-37
content in chondritic meteorites and iron and lead from recovered satellites, 16: 16080

ARGON ISOTOPES Ar-40
ratio with argon-36 in geothermal bores, fumaroles, and pools in New Zealand, 16: 16581

ARGON ISOTOPES Ar-41
content and escape velocity in swimming pool reactor, 16: 17312

ARGON–OXYGEN SYSTEMS
electron transfer collisions near adiabatic conditions, 16: 16868

ARGONNE HEAVY WATER REACTOR
fuel element design and performance, review, 16: 16669

ARGONNE SYNCHROTRON
integrator switch design and operation for monopolar signal, 16: 17169

ARMY REACTORS (PL-3)
design, boiling water concept, 16: 17284 (APAE-115(Vol.I))
design, pressurized water concept, 16: 17285 (APAE-115(Vol.II))

ARMY REACTORS (SM-1)
fuel element design and performance, review, 16: 16669

ARMY REACTORS (SM-2)
materials development studies, 16: 17229(R) (BMI-1565(Del.))

ARSENIC CHLORIDES
exchange reactions with chlorine in gas chromatography, 16: 16371

ARSENIC FLUORIDES
nuclear magnetic resonance of arsenic-75 in liquid, at room temperature, 16: 16361

ARSENIC ISOTOPES As-75
nuclear magnetic resonance in arsenic fluoride at room temperature, 16: 16361
nuclear quadrupole resonance in sodium arsenate, 16: 16360

ARTERENOL
protective effects against radiation injuries and nitrogen mustard in *E. coli*, 16: 16297

ASPARTIC ACID
determination in protein hydrolyzates using carbon-14 or tritium labeled 1-fluoro-2,4-dinitrobenzene, 16: 16089

ASTATINE
separation from tellurium, chromotographic, 16: 16397

ASTRONAUTICS
bibliography, 16: 17317 (NP-11476)
bibliography, 16: 17318 (NP-11493)
bibliography of JPL publications, July 1960 to June 1961, 16: 17319 (NP-11568)
conference, 16: 17323

ASTROPHYSICS
atmospheric turbulence in nearly stable stars, 16: 16904
dynamics of atmospheres and outer layers of intrinsic variable stars, 16: 16905
dynamics of cosmic gases, review, 16: 16902
motion in lower solar atmosphere near activity transients, 16: 16911
shock-wave effects in variable-density stars, 16: 16906
shock wave propagation in collisionless plasma, 16: 16913
shock waves in collisionless regions of stellar coronae, 16: 16912
solar photospheric convection and granulations, 16: 16909
stellar mass loss by steady-state gas outflow, 16: 16907
stellar mass loss by steady-state gas outflow, 16: 16908
velocity fields in stellar atmospheres, 16: 16910

ATLANTIC OCEAN
silts accumulation rates in, thorium-230/thorium method for determination, 16: 16583

ATMOSPHERE
analysis for tritium content of methane in, over Australia, Singapore, and United Kingdom, 1957 to 1959, 16: 16079
circulation, determination by tracing cosmic-ray-produced radioisotopes, 16: 16585
circulation, determination by tracing cosmic-ray-produced radioisotopes, 16: 16587
circulation, determination by tracing cosmic-ray-produced radioisotopes, 16: 16589
fall-out monitoring in Antarctica and between 60°N and 70°S, 16: 16042
particle transport, tracer study, 16: 16584

ATMOSPHERES
velocity fields in pulsating, bibliography, 16: 16905

ATOMIC ENERGY
bibliography on bibliographies, 16: 16030 (TID-3710)
employment opportunities in, 16: 16031 (TID-14314)
legal, legislative, and regulatory literature, survey, 16: 16035

ATOMIC EXPLOSIONS
use of contained, for propulsion of space vehicles, 16: 17328

ATOMIC PHYSICS
book: *Group Theory*, 16: 16639

ATOMS
hypervirial average values for nonrelativistic and relativistic, 16: 16815

AURORAL STORMS
measurements during IGY, survey, 16: 16817

AUSTRALIA
tritium content in atmospheric methane over, 1957 to 1959, 16: 16079

B

BACTERIA
activation of latent dysentery, during radiation sickness in monkeys, 16: 16295
radiation effects, gamma, heavy ion, and x, 16: 16189
radiosensitivity, effects of vitamin K and its analogs, 16: 16220

BALANCES
design for ferromagnetic and paramagnetic measurements, 16: 16513 (AE-64)

BARIUM
separation from cadmium by coprecipitation with cadmium–cerium alloy, 16: 16464

BARIUM FLUORIDE CRYSTALS
cohesive and surface energies of fluorite structure, 16: 16386

BARIUM ISOTOPES Ba-134
excited state spectrum, first, 16: 17108

BARIUM ISOTOPES Ba-140
effects of injected, on blood picture, 16: 16237

BARIUM SULFATES
reactions with clays, solid state formation of feldspars in, 16: 16578

BEARINGS
lubrication, magnetohydrodynamic theory of, 16: 16855
wear of turbo-assembly suspension-type, tracer studies, 16: 16065

BEARTOOTH MOUNTAINS (MONT.)
zircon ages, 16: 16577 (TID-14861(Vols.I&II))

BEHAVIOR
effects of irradiation during fetal development, in rats, 16: 16221
radiation effects, 16: 16269
radiation effects of pre-natal irradiation, 16: 16271
radiation effects on development, 16: 16272

BELGIAN REACTOR-1
transfer tube design and performance, fast pneumatic, 16: 17313

BENZALDEHYDE
Cannizzaro reactions in methanol at 100°C, mechanism of homogeneous, 16: 16087

BENZENE
exchange reactions with deuterium oxide, mechanism of platinum

catalyzed, 16: 16344
quenching properties for use in Geiger counters, 16: 16101
radiolysis, effects of electric fields, 16: 16409(R) (TID-15424)
radiolysis of mixture with benzoyl chloride, formation of isomers in, 16: 16436
reactions with tritium recoils, 16: 16442
scavenger effects on gamma radiolysis of methylcyclohexane, mechanisms, 16: 16418

BENZENE, BROMO-
radiolysis, formation of isomers in, 16: 16436

BENZENE, NITRO-
exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344

BENZENES
analytical use of carbon-14 or tritium labeled fluorodinitro-, in determination of amino acids, 16: 16089

BENZENES, ALKYL-
properties as radiation-resistant lubricants, 16: 16797(P)

BENZOIC ACID
analysis for carbon-14 and tritium by liquid scintillation, 16: 16091

BENZOIC ACID, BENZYL ESTER
Cannizzaro reactions in methanol at 100°C, mechanism of homogeneous, 16: 16087

BENZONITRILE
exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344

BENZOPHENONES
preparation by gamma irradiation of benzene–benzoyl chloride mixture, 16: 16436

BENZOYL HALIDES
radiolysis of benzene–benzoyl chloride mixture, formation of isomers in, 16: 16436

BERYLLIUM
analysis for molybdenum and tin by solvent extraction with 8-quinolinol, spectrophotometric, 16: 16314
bend and tensile properties in sheet, variations in room temperature, 16: 16751
bonding to uranium dioxide by gas-pressure methods, 16: 17229(R) (BMI-1565(Del.))
casting and melting by induction, defects in, 16: 16651
chemical technology and metallurgy, 16: 16771
coating, methods and properties comparisons, 16: 16653
detection in minerals and aerosols by (γ,n) reaction, design of apparatus for, 16: 16321
dissolution in hydrochloric acid, disintegration during, 16: 16373
ductility and preparation of pure, 16: 16725(R) (NMI-9517)
impurity segregation in commercial, during thermal treatment, 16: 16740
mechanical properties and structural response of hot cross-rolled, hot-pressed, and hot-upset sheet, 16: 16714 (ASD-TR-61-87)
secondary ion emission during ion bombardment, 16: 16880
structural properties and uses in reactors, survey, 16: 16036
thermal cycling, 16: 16732 (TIM-312)

BERYLLIUM ALLOYS
structural properties and uses in reactors, survey, 16: 16036

BERYLLIUM–CHROMIUM ALLOYS
crystal structure of $CrBe_{12}$ in, 16: 16717 (DC-58-11-114)

BERYLLIUM COMPLEXES
with bipyridyl, colors of alkyl and halide, 16: 16382

BERYLLIUM CRYSTALS
electric conductivity and temperature coefficient of conductance of poly- and single-, effects of purity on, 16: 16749

BERYLLIUM ISOTOPES Be-7
atmospheric distributions and fall-out of cosmic-ray-produced, 16: 16587
atmospheric distribution and fall-out of cosmic-ray-produced, 16: 16589
atmospheric production and fall-out of cosmic-ray-produced, 16: 16585

BERYLLIUM ISOTOPES Be-9
neutron scattering at 0.1 to 2.4 Mev, polarization asymmetries, 16: 17091

BERYLLIUM–NIOBIUM ALLOYS
crystal structure of $NbBe_{12}$ in, 16: 16717 (DC-58-11-114)

BERYLLIUM NITRATES
preparation, properties, and structure of basic, 16: 16380

BERYLLIUM OXIDE COMPACTS
carbon inclusions, dislocations, and porosity of hot-pressed, electron microscope studies, 16: 16735(T) (AEC-tr-5028)

BERYLLIUM OXIDE REACTOR EXPERIMENT
design and operation, safeguards report, 16: 16604 (GA-1100(Suppl.3))

BERYLLIUM OXIDE–TUNGSTEN SYSTEMS
neutron attenuation, 16: 17237 (NASA-TN-D-1184)

BERYLLIUM OXIDES
neutron attenuation, 16: 17237 (NASA-TN-D-1184)
properties and uses in reactors, survey, 16: 16036

BERYLLIUM–VANADIUM ALLOYS
crystal structure of VBe_{12} in, 16: 16717 (DC-58-11-114)

BETA DECAY
axial vector renormalization in, 16: 17124
positron polarization, two-component theory for, 16: 16059
pseudoscalar interactions in, 16: 17080

BETA PARTICLES
angular correlation measurements, data recording system for, 16: 16636
counting with Geiger-Mueller counter, absolute, 16: 16545
detection and measurement in man, whole-body counting, 16: 16140
detection and measurement in man, whole-body counting, 16: 16145
detection, design of radiometer for, 16: 16539
emission from nuclei, lifetime for l-forbidden, 16: 17122
neurological effects on isolated nerves, 16: 16255
neurological effects on central nervous system of rats, aerobic and anaerobic metabolic studies, 16: 16274

BETA SOURCES
development for irradiation of isolated nerves, 16: 16255
production by cathode sputtering, chamber design for, 16: 16433

BETA SPECTROMETERS
design and use of permanent magnet, 16: 16536
design of permanent magnet, 16: 16537
design of permanent magnet, 16: 16538
magnetic field coil system for curved exit slit type, calculations for, 16: 16550

BETA SPECTROSCOPY
applications in radio-column chromatographic assay of tritium labeled compounds, 16: 16096

BETATRONS
bremsstrahlung beam collimation, neutron background from, 16: 17158 (SCR-481)
electron oscillations, measurement by rapid photography, 16: 17171

BIBENZYL
exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344

BIBLIOGRAPHIES
on analytical applications of mercury electrode, 16: 16318
on astronautics, 16: 17317 (NP-11476)
on astronautics, 16: 17318 (NP-11493)
on bibliographies of atomic energy literature, 16: 16030 (TID-3710)
on cross sections for neutron inelastic scattering and (n,2n) processes, 16: 17074 (VDIT-50)
on defense metals accessions, 16: 16727 (NP-11553)
on direct energy conversion by thermionic and magnetohydrodynamic generators, 16: 16808 (NP-11472)
on elastomer properties, 16: 16302 (ASD-TR-61-234)
on fuel element fabrication and performance, 16: 16654
on isotope separation by gas centrifugation, 16: 16627 (NUCLEAR-52)
on metabolism of insecticides in animals, 16: 16113
on metabolism of organophosphate insecticides by plants, 16: 16112
on neutron measurement methods, 16: 17058 (NYO-7877(Rev.1))
on publications of Jet Propulsion Laboratory, July 1960 to June 1961, 16: 17319 (NP-11568)
on radioisotopes in biological and ecological studies of insects, 16: 16109
on reactor fuel processing, 16: 16464
on shielding, annotated, 16: 17222 (NP-11466)
on thermionic and thermoelectric conversion systems, 16: 17315 (JPLAI-LS-392)
on velocity fields in pulsating atmospheres, 16: 16905

BIOLOGICAL MATERIALS
analysis for ruthenium-103 and ruthenium-106, radiochemical method,

16: 16309 (PG-Report-308)
analysis for tritium by gas counting, zinc fusion method for, 16: 16102
analysis for tritium with single phototube liquid scintillation counter, 16: 16098
radiation effects, review, 16: 16180(T) (JPRS-13154(p.1-8))

BIOLOGICAL SYSTEMS
radiation effects on, galactic, 16: 16192

BIPHENYL
exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344
radiolysis, isotope effects of deuterium and tritium in, 16: 16086

BIPHENYL, BROMO-
formation of isomers, in gamma radiolysis of bromobenzene, 16: 16436

BIPYRIDINES
complexes with beryllium alkyls and halides, colors, 16: 16382

BIRDS
radiation effects on brain, comparison of sensitivity of various parts, 16: 16281

BISMUTH
separation from cadmium, copper, lead, silver, and zinc by anion exchange, 16: 16463

BISMUTH (LIQUID)
thermophysical properties, 16: 16741

BISMUTH ISOTOPES Bi-205
decay scheme, 16: 17096

BISMUTH ISOTOPES Bi-206
decay scheme, 16: 17096
uptake by tumors, 16: 16249
uptake by tumors, 16: 16252

BISMUTH ISOTOPES Bi-209
photoneutron angular distribution forward asymmetry, 16: 17089

BISMUTH ISOTOPES Bi-210
beta spectrum, 16: 17105

BISMUTH ISOTOPES Bi-212
decay schemes, 16: 17082

BISMUTH–LEAD ALLOYS
superconductivity, 16: 16830

BISMUTH TELLURIDES
thermoelectric properties, 16: 16708(R) (AD-266128)

BISMUTH–URANIUM ALLOYS
analysis for uranium, controlled potential coulometric, 16: 16310

BLAST EFFECTS
on structures in Upshot-Knothole Operation, 16: 16482 (WT-740)

BLOOD
carbon monoxide formation in irradiated, effects of triethylenetetracemine compounds on, 16: 16292
Dieldrin content and effects in mice, injected, 16: 16114
radiation sickness effects on isoserological properties, 16: 16290

BLOOD PICTURE
as indication of radiation dose, 16: 16238
effects of injected radioisotopes of strontium, barium, and cesium, 16: 16237

BLOOD PLASMA
radioactivity ratio with erythrocytes, use in diagnosis of thyroid toxicosis, 16: 16169
separation of erythropoietic factor from, by ion exchange, 16: 16164(P)

BLOOD VESSELS
radiation effects from esophagus cancer therapy, 16: 16208

BLOOD VOLUME
measurement in rats using chromium-51 and weight determinations, 16: 16103 (CEA-2112)

BLOWERS
bearing and gas-lubricated face seal designs for, 16: 16484

BODY FLUIDS
scintillation counting, solvent systems for, 16: 16166

BOILERS
calculations for once-through, for gas-cooled reactors, 16: 16509
design for gas-cooled reactors, 16: 17268(P)
weight analysis for sodium–potassium alloy to mercury, 16: 16502 (FXM-208)

BOILING
film, on horizontal plate, 16: 16508
nucleate pool, heat transfer, 16: 16503 (NP-11491)

BOILING REACTOR EXPERIMENTS
fuel element design and performance, review, 16: 16669

BOILING REACTORS
control by valve and reflector, 16: 17305(P)
design for vapor-liquid separation by centrifugal action, 16: 17270(P)
design of natural-circulation, for prevention of burnout, 16: 17259(P)
design of superheating, 16: 17304(P)
fuel cycle costs, effects of uranium-235 price reduction, 16: 17298 (ORNL-TM-191)
stability, static hydraulic, 16: 17242(T) (AEC-tr-4995)

BONDING
development of high-temperature high-pressure gas method, 16: 16701
development of process for cold, 16: 17229(R) (BMI-1565(Del.))
of fuel element cladding, review, 16: 16666

BONE MARROW
body content determination, tracer method, 16: 16107
transplantation in lethally irradiated rats, intraosseous method for, 16: 16291
transplantation of rat into mice, effects on acceptance of skin grafts from rats, 16: 16178 (USNRDL-TR-553)

BONES
calcium metabolism, effects of whole-body irradiation, 16: 16232
metabolism, tracer study, 16: 16159
metabolism, tracer study, 16: 16161
radiation effects of external, high-level gamma exposure, 16: 16194

BORON
determination in uranium compounds, spectrographic, 16: 16304 (CNEN-96)
determination in uranyl nitrate solutions by absorptiometric techniques, 16: 16308 (PG-Report-296)
neutron scattering at 0.1 to 2.4 Mev, polarization asymmetries, 16: 17091

BORON COMPOUNDS
preparation and differential uptake of boron-10-containing by brain tissue and tumors, 16: 16250

BORON FLUORIDES
erosive effects on refractory materials at 3000°K, 16: 16726(R) (NP-11311)

BORON ISOTOPES B-8
production in proton-nucleus reactions at 24.8 Bev/c, angular and energy distributions, 16: 16940 (NP-11592(Vol.I)(p.117-20))

BORON ISOTOPES B-10
neutron capture, applications in therapy of brain tumors, 16: 16215
neutron capture, applications in therapy of brain tumors, 16: 16250

BORON ISOTOPES B-11
alpha reactions (α,n), angular distributions from, 16: 17119

BOSONS
interactions of highly relativistic, model, 16: 16950 (NP-11592(Vol.I)(p.191-5))
resonances and threshold mass numerologies in, 16: 17028

BOUNDARY LAYER
magnetohydrodynamic, in flow of incompressible conducting fluid past magnetized flat plate, 16: 16512

BRAIN
Dieldrin content and effects in mice, injected, 16: 16114
irradiation of small areas in treatment of certain nervous and psychic disorders, 16: 16246
irradiation of small areas with collimated monoenergetic proton beams, 16: 16248
potential of cerebral cortex, ultraslow rhythmic fluctuations, 16: 16184(T) (JPRS-13154(p.34-8))
radiation dosage measurements in, 16: 16251
radiation effects, 16: 16243
radiation effects on visual cortex in cats, 16: 16263
radiation effects on electrical activity in cats and rabbits, 16: 16264
radiation effects on activity in cats and rats at low doses, 16: 16268
radiation effects on 3-(2-aminoethyl)-5-indolo content in rats, 16: 16273
radiation effects on glycogen appearance in, 16: 16275
radiation effects on cell bodies and vascular structures, histochemical studies, 16: 16276
radiation effects, review, 16: 16182(T) (JPRS-13154(p.15-20))

radiation effects on electric properties of cerebral cortex, 16: 16183(T) (JPRS-13154(p.21-34))
radiation effects on ultraslow potential fluctuations in cerebral cortex, 16: 16185(T) (JPRS-13154(p.38-55))
radiation injuries, histology and dosimetry, 16: 16251
radiosensitivity, comparison of various parts, 16: 16281

BRAIN TUMORS
diagnosis by gamma encephalography, 16: 16244
diagnosis by gamma encephalography, 16: 16247
localization and diagnosis by differential uptake of bismuth-206, 16: 16249
localization and diagnosis by differential uptake of bismuth-206, 16: 16252
localization by scintillation scanning after administration of Neohydrin labeled with mercury-203, 16: 16231
radiation effects on electroencephotographs, 16: 16260
radiodiagnosis, 16: 16241
radiotherapy, 16: 16241
radiotherapy, use of neutron capture technique, 16: 16215
radiotherapy with boron slow neutron capture technique, 16: 16250
therapy, use of radioisotopes as radiation source, 16: 16245

BRASS
adhesion to ethylene propylene rubber, 16: 16707(R) (AD-265319)
analysis for molybdenum and tin by solvent extraction with 8-quinolinol, spectrophotometric, 16: 16314
reactions with phosphorus and sulfur compounds in oils, up to 700°C, 16: 16054

BRAZING
torch for reactive metals, 16: 16492(P)

BRAZING ALLOYS
corrosion resistance in pressurized water at 565°F for use in joining stainless steel-clad fuel elements, 16: 16675 (ORNL-2834)

BREEDER REACTORS
characteristics of BR-5, 16: 17247

BREMSSTRAHLUNG
detection and measurement from pure beta-emitters in man, whole-body counting, 16: 16140
detection and measurement in man, whole-body counting, 16: 16145
model for very-high–energy, field theoretical, 16: 16950 (NP-11592 (Vol.I)(p.191-5))
spectra from phosphorus-32 and yttrium-90, internal, 16: 17107

BROMINE IONS
electron transfer collisions near adiabatic conditions with xenon, 16: 16868

BROMINE ISOTOPES Br-82
determination in man, whole-body counting, 16: 16158
tracer studies with iodine-131 mixtures, 16: 16105

BROOKHAVEN REACTOR
fuel element design and performance, review, 16: 16669

BUBBLE CHAMBERS
research programs on hazards of hydrogen, 16: 16610(R) (TID-15422)

BUBBLES
effects on hardening of crystalline solids, semicircular dislocation model for, 16: 16711 (AERE-M-1000)
formation and departure in nucleate pool boiling, 16: 16503 (NP-11491)

BURROS
radiation effects on central nervous system, 16: 16277

BUTADIENE
radioinduced polymerization, 16: 16450(P)

BUTADIENE, CHLORO- POLYMERS
radiation effects on mechanical properties, 16: 16445(P)

1,3-BUTADIENE, 2-METHYL-
quenching properties for use in Geiger counters, 16: 16101
radioinduced polymerization, 16: 16450(P)

BUTYL PHOSPHATE–NITRIC ACID–URANYL NITRATE SYSTEMS
decomposition kinetics, 16: 16464

BUTYL PHOSPHATES
solvent properties for uranium, 16: 16464

BUTYRIC ACID, α-AMINO-γ-MERCAPTO-, THIOLACTONE
protective effects against radiation injuries and nitrogen mustard in *E. coli*, 16: 16297

C

CADMIUM
determination in lithium chloride–potassium chloride eutectic, controlled potential coulometric, 16: 16310
diffusion and solubility in germanium at 700 to 930°C, tracer study, 16: 16057
separation from bismuth, copper, lead, silver, and zinc by anion exchange, 16: 16463

CADMIUM (LIQUID)
solvent properties for cobalt, chromium, and rare earths, 16: 16464

CADMIUM–CERIUM ALLOYS
coprecipitation with metals from cadmium(liquid), 16: 16464

CADMIUM ISOTOPES Cd-107
electron capture gamma spectra, 16: 17125

CADMIUM ISOTOPES Cd-110
excited state spectrun, first, 16: 17108

CADMIUM ISOTOPES Cd-112
excited state spectrum, first, 16: 17108

CADMIUM ISOTOPES Cd-114
excited state spectrum, first, 16: 17108

CADMIUM ISOTOPES Cd-116
excited state spectrum, first, 16: 17108

CADMIUM SULFIDE CRYSTALS
electroluminescence in d-c fields, 16: 16858
luminescence behavior at −180 to 150°C, 16: 16863
photochemical reactions and quenching, mechanism, 16: 16862
radiation effects on photocurrent spectral distribution, 16: 16793

CALCIUM
metabolism in bone, effects of whole-body irradiation, 16: 16232
self-diffusion in melts containing silica and sodium oxide, lithium oxide, calcium oxide, and potassium oxide, 16: 16048

CALCIUM FLUORIDE CRYSTALS
cohesive and surface energies of fluorite structure, 16: 16386
thermoluminescence, 16: 16859

CALCIUM IONS
thermodynamic equilibrium in chronosphere, departures from, 16: 16898

CALCIUM ISOTOPES Ca-40
electron scattering, shell structure from proton emission in, 16: 17095
energy levels excited by 6.6-Mev protons, 16: 17146
gamma reactions (γ,p) at 22 Mev, proton energy and angular distribution, 16: 17139
nucleon scattering at high energies, Pauli exclusion effects in, 16: 17121
proton inelastic scattering at 6.6 Mev, 16: 17146

CALCIUM ISOTOPES Ca-45
determination by liquid scintillation counting in ethanol-ethylene glycol–nitric acid–toluene solvent, 16: 16316

CALCIUM ISOTOPES Ca-47
determination in man, whole-body counting, 16: 16159
determination in man, whole-body counting, 16: 16160
determination in man, whole-body counting, 16: 16161

CALCIUM OXIDES
diffusion of calcium, potassium, and sodium ions in, in melts with silicon oxide–sodium oxide systems, 16: 16048

CALDER HALL REACTORS
fuel element design and performance, review, 16: 16669
reactivity changes, calculation of long-term, 16: 17240 (TRG-Report-130)

CALIFORNIUM
separation from curium by solvent extraction, 16: 16469(P)

CALIFORNIUM ISOTOPES Cf-252
fission fragment stopping in emulsions, 16: 17078

CANADA
fall-out levels, 1960, 16: 16598 (CNHW(RP-4))

CANDU REACTOR
coolant development, 16: 17299(R) (SRO-66)

CANNIZZARO REACTION
mechanism of homogeneous, in methanol at 100°C, 16: 16087

CARBON
abundance in high-velocity A stars, 16: 16896
coating with carbides and metallic compounds for impermeability, 16: 17263(P)

cosmic particle reactions at 20 to 150 Bev, nucleon interactions from, 16: 17114
determination in sodium, 16: 16690 (TID-7626(Pt.I)(p.146-9))
electron scattering cross sections, 16: 16866
electron transfer collisions near adiabatic conditions with argon, krypton, and xenon, 16: 16868
electronic energy of molecular, 16: 16357
inclusion in hot-pressed beryllium oxide, electron microscope studies, 16: 16735(T) (AEC-tr-5028)
mass spectra in noble-gas matrices, 16: 16726(R) (NP-11311)
mass transfer in liquid sodium systems, 16: 16682 (TID-7626(Pt.I) (p.92-100))
metallurgical effects on high-purity niobium, 16: 16747
neutron reactions, removal cross sections, 16: 17064 (CNLM-3244)
neutron removal cross sections, 16: 17059
potential energy curves for diatomic, 16: 16821
properties of impermeable, 16: 16765
reactions with neon-20 and nitrogen-14 ions, nitrogen-17 production, 16: 17153

CARBON COMPOUNDS
reactions with oxidizing gases, 16: 16338 (NPCC/MWP(G)P180)

CARBON DIOXIDE–GRAPHITE SYSTEMS
radiation effects, 16: 16407 (NPCC/MWP(G)/P157)

CARBON DIOXIDES
determination in geothermal bores, fumaroles, and pools in New Zealand, mass spectrometric, 16: 16581
diffusion coefficients in water, continuous measurements using glass scintillators, 16: 16351
electron transfer collisions near adiabatic conditions with hydrogen ions, 16: 16868
electronic energy, 16: 16357
erosive effects on refractory materials at 3000°K, 16: 16726(R) (NP-11311)
radiation effects, 16: 16407 (NPCC/MWP(G)/P157)
reactions with graphite under irradiation, theory, 16: 16408 (NPCC/MWP(G)/P161)

CARBON IONS
electron transfer collisions near adiabatic conditions with argon, hydrogen, krypton, and xenon, 16: 16868

CARBON–IRON–URANIUM SYSTEMS
compound formation in, UFeC$_4$, 16: 16757

CARBON ISOTOPES C-11
determination in man, whole-body counting, 16: 16160
energy levels from proton reactions with oxygen-16 at 146 Mev, 16: 17088

CARBON ISOTOPES C-12
alpha scattering at 42 Mev, magnetic analysis, 16: 16542
deuteron elastic scattering, cross sections and polarizations in, 16: 17130
energy levels from proton reactions with fluorine-19 at 143 Mev, 16: 17088
neutron scattering at 0.1 to 2.4 Mev, polarization asymmetries, 16: 17091
nucleon scattering at high energies, Pauli exclusion effects in, 16: 17121
photon absorption giant resonance, dipole, 16: 17109
ratio with carbon-13 in bores, fumaroles, and pools in New Zealand, 16: 16582

CARBON ISOTOPES C-13
photon absorption giant resonance, dipole, 16: 17109
ratio with carbon-12 in bores, fumaroles, and pools in New Zealand, 16: 16582

CARBON ISOTOPES C-14
counting in volatile labeled compounds, 16: 16412
determination in organic compounds by liquid scintillation, 16: 16091
tracer application in determination of amino acids in protein hydrolyzates, 16: 16089

CARBON MONOXIDES
electronic energy, 16: 16357
erosive effects on refractory materials at 3000°K, 16: 16726(R) (NP-11311)
formation in animals during radiation sickness, effects of triethylenetetramine compounds on endogenic, 16: 16292

CARBON STEEL
corrosion by mercury at 600–1400°F, 16: 16677 (TID-7626(Pt.I)(p.23-34))
radiation damage assessment by nondestructive techniques, 16: 16791

CARBONYL GROUP
interactions with beryllium and molybdenum, secondary ion emission, 16: 16880

CARCINOMAS
radioinduced using cerium-144 in lungs, 16: 16177 (NYO-10056)

CAROLINAS-VIRGINIA TUBE REACTOR
development, 16: 17299(R) (SRO-66)
development, 16: 17300(R) (WCAP-4123)
hazards summary, accident evaluation, 16: 16601 (CVNA-90(Pt.B, Vol.III))
hazards summary, design of plant and reactor, 16: 16600 (CVNA-90 (Pt.B,Vol.II))
hazards summary, plant operation basic policy, 16: 16602 (CVNA-90 (Pt.B,Vol.IV))
hazards summary, site description, 16: 16599 (CVNA-90(Pt.B,Vol.I))

CASCADE RANGE (U. S.)
rock ages, argon-potassium, 16: 16577 (TID-14861(Vols.I&II))

CATALINA MOUNTAINS (ARIZ.)
zircon ages, 16: 16577 (TID-14861(Vols.I&II))

CATHODES
performance of carbide, at 2100 to 2500°K, redeposition effects, 16: 16807(R) (GA-3093)

CATIONS
separation by ion exchange using sulfosalicylic acid as complexing agent, 16: 16329

CATS
radiation-conditioned behavior, effects of habituation to laboratory and radiation procedures, 16: 16266
radiation effects on ventral root potentials in spinal cord, 16: 16261
radiation effects of neuronal activity in spinal cord, 16: 16262
radiation effects on response of visual cortex, 16: 16263
radiation effects on brain electrical activity in, 16: 16264
radiation effects on brain activity at low doses, 16: 16268

CATTLE
radiation effects on Purkinje fibers of heart, 16: 16279

CAVITY RESONATORS
use for plasma compression, 16: 17217(P)

CELLULOSE ACETATES
columns with dithizone for separation of indium, development of chromatographic, 16: 16319

CENTRIFUGATION
use in preparation of uniform layers of precipitates for radioactivity measurements, 16: 16427

CENTRIFUGES
design for particle size analysis of powders, 16: 16491(P)
design of gas, for isotope separation, 16: 16630(P)
design of laboratory, for use in glove box, 16: 16486(P)
design of separators, review, 16: 16458

CERAMIC MATERIALS
corrosion by molten LAMPRE fuel at 900 to 1000°C, 16: 17297(R) (LAMS-2681)

CERIUM
electronic state in cerium–thorium alloys, 16: 16748
nuclear magnetic moments, spin-orbit coupling, and hyperfine fields, 16: 16831
solubility in lead–zinc alloys(liquid), 16: 16464
specific heats at 300 to 1000°K, 16: 16746

CERIUM (LIQUID)
corrosive effects on molybdenum at 800 to 1200°C, 16: 16693

CERIUM–COBALT ALLOYS
structure of Ce$_{24}$Co$_{11}$, 16: 17297(R) (LAMS-2681)
thermomagnetic properties down to liquid helium temperatures, 16: 16742

CERIUM–COBALT–PLUTONIUM ALLOYS
corrosive effects on tantalum at 750 to 900°C, 16: 17297(R) (LAMS-2681)

CERIUM ISOTOPES Ce-144
carcinogenic effects on lungs in rats, 16: 16177 (NYO-10056)
properties as heat sources, 16: 16464
sorption from aqueous solutions by manganese dioxide, 16: 16389

CERIUM–MANGANESE–URANIUM ALLOYS
  phase studies, eutectic temperature and composition, 16: 17297(R) (LAMS-2681)
CERIUM SULFIDES
  thermal properties of semiconducting at 800°K, 16: 16799(R) (AD-265462)
CERIUM–THORIUM ALLOYS
  electronic state of cerium in, 16: 16748
CESIUM
  electron reactions, elastic scattering and momentum transfer cross sections, 16: 16800(R) (AD-266440)
  ionization in electric discharge, nonthermal, 16: 16856
  magnetic spin susceptibility and thermal conductivity, 16: 16713 (AROD-431:44)
  separation from fission product solutions using zirconium phosphate dessicated at high temperature, 16: 17337
  work functions in thermionic cells, collector-emitter differences, 16: 16842
CESIUM (LIQUID)
  corrosive effects on refractory alloys and metals at 1600 to 2500°F, 16: 16684 (TID-7626(Pt.I)(p.109-10))
  corrosive effects on refractory metals at 1290 to 1830°F, 16: 16678 (TID-7626(Pt.I)(p.42-62))
CESIUM BROMIDES
  thermodynamic properties, 16: 16358
CESIUM CHLORIDES
  reactions with plutonium(III) chlorides and chlorine gas, formation of plutonium(IV) ions by, 16: 16367
  thermodynamic properties, 16: 16358
CESIUM FLUORIDES
  thermodynamic properties, 16: 16358
CESIUM IODIDES
  thermodynamic properties, 16: 16358
CESIUM IONS
  interactions with molybdenum, secondary ion emission, 16: 16881
CESIUM ISOTOPES Cs-133
  hyperfine structure, 16: 17128
CESIUM ISOTOPES Cs-134
  determination in animal and plant tissues, ashing procedures for, 16: 16165
  sorption from aqueous solutions by manganese dioxide, 16: 16389
CESIUM ISOTOPES Cs-137
  determination by ferrocyanite precipitation, 16: 16324
  determination in man, whole-body counting, 16: 16139
  determination in man, whole-body counting, 16: 16162
  effects of injected, on blood picture, 16: 16237
  half life determination, internal standard technique for thermal ionization mass spectrometric, 16: 16317
  metabolism in man, effects of dietary potassium levels, 16: 16152
  properties as heat sources, 16: 16464
  separation from fission products, 16: 17336
  use in radiotherapy of tumors, 16: 16168
CESIUM NITRATES
  radiolysis, effects of intensity on, 16: 16425
CHARGED PARTICLE BEAMS
  transport system design and construction, 16: 17160
  wave excitation effects in plasma, 16: 17185(T) (JPRS-12990(p.367-71))
CHARGED PARTICLES
  bending of high energy in nuclear emulsions by magnetic fields, 16: 16966 (NP-11592(Vol.I)(p.301-5))
  Cherenkov emission from circular orbit, in external magnetic field, 16: 17033
  detection and measurement, characteristics of silicon npp$^+$ junctions for, 16: 16546
  energy of ground state interacting systems, calculation for attractive inverse square forces, 16: 17034
  identification by mass, computer design for, 16: 16635
  mass and energy losses in absorbing media with space dispersion macroscopic renormalization, 16: 16885
  motion in inhomogeneous magnetic field, 16: 17197
  motions in isotropic media, electromagnetic field properties from relativistic, 16: 17009
  radiation emission in plasma, transition, 16: 17207
CHEMICAL PROPHYLAXIS
  combined use of histamine, mercamine, or tryptamine as, 16: 16296
  of radiation injuries, Japanese research, 16: 16298
  of toxic effects of radiation and nitrogen mustard in *Escherichia coli*, 16: 16297
CHEMICAL RADIATION DETECTORS
  performance of benzoic acid, for measuring absorbed dose rate of electrons in water, 16: 16555
CHERENKOV RADIATION
  emission by charged particles in circular orbit in external magnetic field, 16: 17033
  review, 16: 17077
CHICKENS
  radiation effects on metabolic reactivity, role of nervous system in, 16: 16284
CHIMERAS
  radiation, rejection of skin grafts and bone marrow transplants, 16: 16178 (USNRDL-TR-553)
CHINON REACTORS (EDF-1)
  control, 16: 17301
CHINON REACTORS (EDF-2)
  control, 16: 17301
CHLORINE
  determination in organic materials, x-ray absorption, 16: 16311
  reactions with alkali chloride–plutonium(III) chloride solutions, formation of plutonium(IV) ions by, 16: 16367
CHLORINE ISOTOPES Cl-34
  beta decay, polarization of positrons from, 16: 16059
CHLORINE ISOTOPES Cl-35
  spectrum rotational structure (F-X) in copper chlorides band, 16: 16345
  spectrum rotational structures in copper chlorides, 16: 16346
CHLORINE ISOTOPES Cl-36
  exchange with chlorine in arsenic(III) and germanium(IV) chlorides gas chromatography, 16: 16371
CHLORINE ISOTOPES Cl-38
  sorption dynamics, physico-chemical analysis, 16: 16440
CHROMATOGRAPHY
  development of radio-column, for analysis of tritium labeled compounds, 16: 16096
CHROMIUM
  determination in uranium compounds, spectrographic, 16: 16304 (CNEN-96)
  emission spectra at high temperatures, pressure effects on, 16: 16819
  oxidation by damp hydrogen at 700 to 900°C, effects of oxygen pressure, 16: 16340(R) (TID-15370)
  solubility in cadmium(liquid), 16: 16464
CHROMIUM–COBALT–IRON–MOLYBDENUM–NICKEL ALLOYS
  aging reactions in René 41, 16: 16718 (DF-59-SL-314)
CHROMIUM–COBALT–NICKEL–TUNGSTEN ALLOYS
  corrosion by potassium-sodium alloys at 1200 to 1500°F, 16: 16681 (TID-7626(Pt.I)(p.87-91))
  corrosion by potassium at 1850°C, 16: 16680 (TID-7626(Pt.I)(p.69-86))
CHROMIUM IONS
  protective effects with hydrofluoric acid, on titanium, 16: 16464
CHROMIUM–IRON–MOLYBDENUM–NICKEL ALLOYS
  corrosion by potassium-sodium alloys at 1200 to 1500°F, 16: 16681 (TID-7626(Pt.I)(p.87-91))
  corrosion by potassium at 1000 to 1800°F, 16: 16679 (TID-7626(Pt.I)(p.63-8))
  corrosion of Hastelloy X by potassium–sodium alloys (liquid) at 1100 to 1500°F, 16: 16691 (TIM-435)
CHROMIUM–IRON–NICKEL ALLOYS
  corrosion by cesium at 1600 to 2500°F, 16: 16684 (TID-7626(Pt.I)(p.109-10))
  fatigue at 1650°F, effects of cycling, environment, and grain size, 16: 16729 (ORNL-3250(Pt.II))
  fatigue, equations for strain behavior, 16: 16728 (ORNL-3250(Pt.I))
CHROMIUM ISOTOPES Cr-51
  decay scheme, 16: 17075
  use in determining blood volumes of rats, 16: 16103 (CEA-2112)
CHROMIUM–NICKEL STEEL

analysis for molybdenum and tin by solvent extraction with 8-quinolinol, spectrophotometric, 16: 16314

CHROMIUM–PLATINUM ALLOYS
atomic magnetic moment of platinum in, 16: 16838

CHROMIUM–SELENIUM SYSTEMS
magnetic structure, temperature effects, 16: 16834

CHROMIUM–URANIUM ALLOYS
separation from fission products extraction with magnesium–silver alloys(liquid), 16: 16464

CHRYSENE
exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344

CIRCUITS
design for a-c polarization of ionization chambers, 16: 16563(P)
design for tripping, for reactors, 16: 17282(P)

CIVILIAN DEFENSE
food and water decontamination and supply in nuclear war, 16: 16591 (AD-264822)

CLAYS
reactions with barium, lead, and strontium sulfates, solid state formation of feldspars in, 16: 16578

COATINGS
for fuel elements, review, 16: 16666

COBALT
solubility in cadmium(liquid), 16: 16464

COBALT CRYSTALS
structure of single, 16: 16731 (PAN-246/I-B)

COBALT–DYSPROSIUM ALLOYS
thermomagnetic properties down to liquid helium temperatures, 16: 16742

COBALT–ERBIUM ALLOYS
thermomagnetic properties down to liquid helium temperatures, 16: 16742

COBALT FORMATES
decomposition, effects of cobalt-60 on rate, 16: 16410(T) (AEC-tr-5054)

COBALT–GADOLINIUM ALLOYS
thermomagnetic properties down to liquid helium temperatures, 16: 16742

COBALT–GALLIUM ALLOYS
phase studies of nitrogen containing, 16: 16768

COBALT–GERMANIUM ALLOYS
phase studies of nitrogen containing, 16: 16768

COBALT–HOLMIUM ALLOYS
thermomagnetic properties down to liquid helium temperatures, 16: 16742

COBALT–INDIUM ALLOYS
phase studies of nitrogen containing, 16: 16768

COBALT–IRON–URANIUM ALLOYS
phase studies, eutectic temperature and composition, 16: 17297(R) (LAMS-2681)

COBALT ISOTOPES Co-55
beta and gamma spectra and energy levels, 16: 17148

COBALT ISOTOPES Co-57
determination in man, whole-body counting, 16: 16161

COBALT ISOTOPES Co-58
determination in man, whole-body counting, 16: 16159
determination in man, whole-body counting, 16: 16162
determination in man, whole-body counting, 16: 16158

COBALT ISOTOPES Co-60
as gamma source for irradiation of thorax, 16: 16227
beta decay, dependence of beta–gamma correlations on electron velocity, 16: 17142
determination in man, whole-body counting, 16: 16159

COBALT–MANGANESE–URANIUM ALLOYS
phase studies, eutectic temperature and composition, 16: 17297(R) (LAMS-2681)

COBALT–NEODYMIUM ALLOYS
thermomagnetic properties down to liquid helium temperatures, 16: 16742

COBALT–NICKEL ALLOYS
atomic magnetic properties, 16: 16839

COBALT–NICKEL–URANIUM ALLOYS
phase studies, eutectic temperature and composition, 16: 17297(R) (LAMS-2681)

COBALT–NITROGEN–ZINC SYSTEMS
phase studies, 16: 16768

COBALT–PALLADIUM ALLOYS
atomic magnetic properties, 16: 16839

COBALT–PLUTONIUM ALLOYS
structure of Pu_6Co, 16: 17297(R) (LAMS-2681)

COBALT–PRASEODYMIUM ALLOYS
thermomagnetic properties down to liquid helium temperatures, 16: 16742

COBALT–RARE EARTH ALLOYS
thermomagnetic properties down to liquid helium temperatures, 16: 16742

COBALT–SAMARIUM ALLOYS
thermomagnetic properties down to liquid helium temperatures, 16: 16742

COBALT–SILICON–URANIUM SYSTEMS
phase studies, eutectic temperature and composition, 16: 17297(R) (LAMS-2681)

COBALT–TERBIUM ALLOYS
thermomagnetic properties down to liquid helium temperatures, 16: 16742

COBALT–TUNGSTEN ALLOYS
corrosion by potassium at 1000 to 1800°F, 16: 16679 (TID-7626(Pt.I) (p.63-8))

COBALT URANATES
magnetic structure, temperature effects, 16: 16834

COBALT–URANIUM ALLOYS
eutectic temperature, 16: 17297(R) (LAMS-2681)

COBALT–YTTRIUM ALLOYS
thermomagnetic properties down to liquid helium temperatures, 16: 16742

COCKCROFT-WALTON ACCELERATORS
stabilization circuit design and performance, 16: 17166

COINCIDENCE CIRCUITS
design and performance of nanosecond, using tunnel diodes, 16: 16557

COINCIDENCE COUNTERS
characteristics and construction of 4π proportional, 16: 16543
design and performance of gamma-proton, 16: 16547

COLD NEUTRONS
scattering by iron(II) chloride, spectroscopy of iron(II) ion by, 16: 16824

COLUMBITES
analysis for niobium and tantalum by ion exchange, 16: 16312

COMPRESSIBLE FLOW
study of two-phase, by growing bubble model, 16: 16504(R) (TID-15429)

COMPUTER PROGRAMS
AUTOTRAN, system for translating from AUTOCODE to FORTRAN, 16: 16631 (AERE-R-3980)
BPG-code for computing criticality of reactors moderated by mixtures of light and heavy water, Burroughs 205, 16: 17286 (BAW-1230(Pt.II))
FORTRAN-II, Monte Carlo calculations of neutron and photon transport problems using CAGE programs and subroutines, 16: 16633 (DC-59-12-83)
MURGATROYD, for analysis of kinetics of Molten Salt Reactor Experiment, 16: 17239 (ORNL-TM-203)
1188/RE for multigroup calculations of effective delayed-neutron fractions and prompt-neutron lifetime, IBM-704, 16: 16632 (ANL-6511)

COMPUTERS
design and performance of analog, for particle identification by mass, 16: 16635
use in processing data on whole-body gamma spectra, 16: 16154
use of magnetic-tape loops for storage and evaluation of gamma spectra, 16: 16153

CONCRETES
gamma and neutron attenuation, calculation methods for, 16: 17161

CONDENSERS
design of retort cover for condensation of magnesium, 16: 16673(P)

CONFERENCES
Advances in the Astronautical Sciences, New York, Jan. 18 to 21, 1960, 16: 17323
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Oct. 1961, 16: 16241
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CONNECTORS (ELECTRIC)
design for round and flat coaxial cables, 16: 16495(P)

CONSTANTS AND CONVERSION FACTORS
on compounds for thermoelectric conversion, 16: 16805 (ARF-3182-5)
tables on nuclear data, 16: 17154

COOLING TOWERS
performance tests, 16: 17307 (JAERI-1022)

COPPER
alloying effects on creep properties of niobium–zirconium alloy, 16: 16772(P)
annealing mechanisms at about 14 to 473°K, 16: 16794
characteristics as radiation target, incorporated into nuclear emulsion, 16: 16967 (NP-11592(Vol.I)(p.307-25))
coating with aluminum oxide by flame spraying, 16: 16641 (ARL-59)
radiation damage assessment by nondestructive techniques, 16: 16791
radiation effects on availability in soils, 16: 16176 (NP-11578)
reactions with neon-20 and nitrogen-14 ions, nitrogen-17 production, 16: 17153
reactions with phosphorus and sulfur compounds in oils, up to 700°C, 16: 16054
separation from bismuth, cadmium, lead, silver, and zinc by anion exchange, 16: 16463
x-ray emission spectra, 16: 16867

COPPER CHLORIDES
spectra, rotational structure of F-X band, 16: 16345
spectra, rotational structures of B and C band, 16: 16346

COPPER CRYSTALS
contamination rate from electron beams, reduction of, 16: 16841
diffusion of antimony in single, at 540 to 650°C, 16: 16045
diffusion of iron in, isotope effects, 16: 16047
diffusion of silver in moving grain boundaries at 725°C, 16: 16046

COPPER–GOLD ALLOYS
x-ray emission spectra, 16: 16867

COPPER ISOTOPES Cu-65
neutron capture cross sections 0.001 to 1 Mev, statistical theory, 16: 17070 (NDA-2093-7)
spectrum rotational structure (F-X) in copper chlorides band, 16: 16345
spectrum rotational structures in copper chlorides, 16: 16346

CORROSION
measurement, method for high sensitivity, 16: 16695

CORROSION INHIBITORS
additive effects on oils, tracer studies, 16: 16064

CORROSION LOOPS
development, 16: 17291(R) (EURAEC-222)
development and operation at G.E. flight propulsion laboratory, 16: 16680 (TID-7626(Pt.I)(p.69-86))
fabrication and operation, of high-temperature liquid metal, 16: 16678 (TID-7626(Pt.I)(p.42-62))
operation of potassium-containing, in SPUR program, 16: 16679 (TID-7626(Pt.I)(p.63-8))

COSMIC MESONS (µ)
momentum spectra at 1 to 20 Bev/c at 37.24 mwe underground, 16: 16919
polarization at high energies, calculation, 16: 16921

COSMIC PARTICLES
charge distribution of heavy primary, over Japan in 1956 and 1957, 16: 16918
reactions with carbon at 20 to 150 Bev, nucleon interactions from, 16: 17114

COSMIC PROTONS
energy spectra and time variations, 16: 16186

COSMIC RADIATION
biological effects of galactic, 16: 16192
composition, energy spectra, and time variations in fourteen events, 16: 16186
intensity measurements in solar system using meteorites as space probes, 16: 16038
intensity measurements in space using meteorites as space probes, 16: 16039
measurements during IGY, survey, 16: 16817
shielding, 16: 16187

COSMIC SHOWERS
detection and measurement of extensive, development of equipment for, 16: 16514 (AFCRL-1092)
initiation lengths and intensities of extensive, 16: 16920
intensities July 1961, Forbush decreases in, 16: 16917

COSMOLOGY
solar system formation time, calculation using nucleosynthesis, 16: 16901

CRYOSTATS
description of helium, for radiation damage studies of metals, 16: 16795

CRYSTAL STRUCTURE
thermodynamic properties of monatomic linear chains, 16: 16864

CRYSTALS
imperfections, use of radioisotope methods in studies of, 16: 16058

CURIUM
separation from californium by solvent extraction, 16: 16469(P)

CURIUM COMPOUNDS
energy levels of salts, calculated from electrostatic matrices, 16: 16356

CURIUM ISOTOPES Cm-242
properties as heat sources, 16: 16464

CURRENT INTEGRATORS
switch design and operation for clamping-unclamping, 16: 17169

CUTTING TOOLS
design of remotely controlled, for opening radioactive tubular containers, 16: 16466(P)
use in narrow channels, coupling for, 16: 16496(P)

CYCLOHEXANE
exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344
radiolysis of liquid, mechanism of unimolecular hydrogen yield in, 16: 16426
radiolysis products, 16: 16431

CYCLOHEXANE, METHYL-
radiolysis of liquid, effects of benzene on gamma, 16: 16418
radiolysis of liquid, yields in gamma, 16: 16417

CYCLOHEXENE
exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344

CYCLOPENTANE
radiolysis of liquid, effects of ethylene on, 16: 16424

CYCLOTRONS
focusing in a microtron, vertical, 16: 17172
ion capture and initial orbits in Karlsruhe isochronous, 16: 17159(T) (UCRL-Trans-812)
magnetic field measurements on UCLA 50-Mev spiral ridge, 16: 17165

CYLINDERS
blast loading tests on horizontal, 16: 16481 (WT-722)

CYSTEINE
protective effects against radiation injuries and nitrogen mustard in *E. coli*, 16: 16297

CYTIDINE, 2′-DEOXY-
urinary excretion in irradiated animals, 16: 16293

CYTOPLASM
radiation effects on liver, whole-body exposure, 16: 16235

D

DATA RECORDING SYSTEMS
design and performance of scaler, for nuclear data, 16: 16636
design for supervising nuclear power plants, 16: 16561(P)

DECAY SERIES
variance for half-life measurements in delayed parent-daughter cascades,

16: 17062 (AROD-2543:6)

DECONTAMINATION
of fixed military facilities during cold weather, 16: 16607 (NDL-TR-24)
of ship surfaces, fall-out simulation for studies, 16: 16611 (USNRDL-TR-549)

DELAYED NEUTRONS
effects on reactor kinetics, computer program for calculation, 16: 16632 (ANL-6511)

DENSITOMETERS
design and performance for measuring neutral gas density near magnetically confined plasma, 16: 17202
design for automatic film badge assessment, 16: 16564(P)

DEUTERIUM
electronic energy of molecular, 16: 16357
enrichment for natural tritium measurements, method for electrolytic, 16: 16083
hyperon (Λ) binding energies in ($_{\Lambda}D$), 16: 17015
isotope effects in radiolysis of organic compounds, 16: 16086
isotope effects in iodide debromination of labeled sym-tetrabromoethane, secondary, 16: 16376
proton capture (p,γ) at 0.275 to 1.75 Mev, cross sections and gamma angular distributions in, 16: 17010

DEUTERIUM HYDRIDES
electronic energy of molecular, 16: 16357
Schmidt numbers for, 16: 16822

DEUTERONS
interactions with hyperons (Σ^+) below 5 Mev, (Σ^+) and (Λ) relative parities in, 16: 17042
interactions with mesons (π^-) three-pion resonances, 16: 16962 (NP-11592(Vol.I)(p.277-82))
neurological effects on mice brains, histochemical studies, 16: 16276
photodisintegration at 11.0 to 22.9 Mev, neutron polarization in, 16: 16924 (NP-11509)
photoproduction, independent pair model and two-stage process in, 16: 17071 (NP-11564)
reactions with strontium, yttrium-86 isomer production in, 16: 17115
scattering by nuclei of low mass, cross sections and polarizations in elastic, 16: 17130

DIAMONDS
photon resonance absorption at 70 kMc, effects of magnetic fields, 16: 16828

DIELECTRICS
radiation testing, methods for in-pile, 16: 16785

DIET
protective effects of egg and milk, against radiation injuries in dog, 16: 16294

DIFFERENTIAL EQUATIONS
book: *Methods of Mathematical Physics. II.*, 16: 16640
solution of vectorial, for pressure-compensated hydromagnetic fields, 16: 16638

DIFFERENTIAL THERMAL ANALYSIS
equipment development for, 16: 16522 (CEA-2094)

DIFFUSION
kinetics in radiation chemistry, one-radical-one-solute model, 16: 16416

DIKETONES, FLUORO-
synthesis of halogenated beta, for solvent extraction of metal values, 16: 16401(P)

DIODES
construction and performance of gallium phosphide, for production of fast light pulses, 16: 16551
magnetic field effects on cesium, 16: 16810(R) (PPL-TR-61-22)

DISASTERS
criticality incident at Idaho Chemical Processing Plant, 16: 16464
safety apparatus for radioactive, 16: 16597 (CEA-2113)

DISEASES
metabolic studies using iron-59, calcium-47, and carbon-11, 16: 16160
potassium levels in patients with muscular dystrophy and related diseases, 16: 16157
radiotherapy of certain nervous and psychic disorders, 16: 16246

DISSOLVERS
design for reactor fuel elements, 16: 16470(P)

DISTILLATION APPARATUS
design for reconcentration of tritium, 16: 16084

DITHIZONE
columns with cellulose acetate for separation of indium, development of chromatographic, 16: 16319

DROSOPHILA
mutations, 16: 16203
radioinduced mutations, 16: 16201
radioinduced mutations, 16: 16202
radioinduced mutations, 16: 16204

DRY BOXES
exposure time in, motion picture analysis, 16: 16616

DUSTS
pulmonary deposition and clearance of inhaled, determined by whole-body counting, 16: 16149

DYES
analysis of 2-nitrophenyhydrazone-, for tritium by liquid scintillation, 16: 16091
determination of Rhodamine B in water, spectrophotometric, 16: 16320

DYSPROSIUM
crystal spin-screw structure, magnetic field effects, 16: 16829
magnetostrictions, effect of helical magnetic structure on, 16: 16882
nuclear magnetic moments, spin-orbit coupling, and hyperfine fields, 16: 16831

DYSPROSIUM ISOTOPES Dy-160
decay, effects of paramagnetism on angular correlation of gamma–gamma cascades in, 16: 17155
energy levels, 16: 17081
excited state spectrum, first, 16: 17108
nuclear magnetic moments, 16: 17155

DYSPROSIUM ISOTOPES Dy-161
spin, 16: 17128

DYSPROSIUM ISOTOPES Dy-163
spin, 16: 17128

DYSPROSIUM OXIDES
thermal expansion coefficients at 25 to 1000°C, 16: 16715(R) (CAL-PI-1273-M-10)

DYSPROSIUM RUTHENATES
magnetic susceptibility at 2 to 1300°F, 16: 16837

E

EGGS
protective effects of dietary, against radiation injuries in dog, 16: 16294
radiation effects on *Artemia*, gamma, heavy ion, and x, 16: 16189
radiation effects on Mexican fruit-fly, in grapefruit, 16: 16123
radiation effects on fertility and survival of grain weevil, continuous and fractionated dose, 16: 16125

ELASTOMERS
adhesion to brass and steel, effects of antimony oxide and Hypalon 40 on, 16: 16707(R) (AD-265319)
aging and stress relaxation of ethylene propylene, effects of antimony oxide and chlorinated paraffin on, 16: 16707(R) (AD-265319)
electrical conductivity of polyethylene and ethylene propylene, 16: 16707(R) (AD-265319)
properties for use on aerospace weapons systems, 16: 16302 (ASD-TR-61-234)

ELECTRIC ARCS
analysis of long, 16: 17182(T) (FTD-TT-61-149)

ELECTRIC CURRENTS
thermionic generation of alternating, 16: 16810(R) (PPL-TR-61-22)

ELECTRIC DISCHARGE
distribution of electrons in electrodeless ring, 16: 17176 (JÜL-33-PP)
emission channel effects on ion, 16: 16814(T) (FTD-TT-62-435)
hydrogen dissociation and ionization in high-frequency, 16: 16871
ignition in hydrogen, application of law of similarity to, 16: 16883
ionization in cesium-helium, nonthermal theory, 16: 16856
plasma instability in toroidal, excited by a traveling electromagnetic field, 16: 17206
plasma-sheath boundary at low pressures, 16: 17201
spatial expansion under homogeneous field conditions, 16: 17204

ELECTRIC INSULATORS
radiation effects in engineering uses, 16: 16625

ELECTRIC POWER
conversion of beta rays to, device for, 16: 16891(P)
generation by thermionic generators, 16: 16848
generation for space vehicles, power plant development for, 16: 17327
generation, Joule cycle development for, 16: 17322
ELECTRIC PROBES
design and performance of electron time-of-flight, 16: 17203
size effects on measurements with, 16: 16553
ELECTROCHEMICAL ANALYSIS
application of mercury electrode, review, 16: 16318
equipment and methods development, 16: 16305(R) (EURAEC-163)
ELECTROLYTES
skin permeability, effects of local high-level irradiation, 16: 16301
ELECTROLYTIC CELLS
current efficiency of aluminum-producing, 16: 16072
ELECTROMAGNETIC FIELDS
propagation of second order correlations in non-stationary, equations for, 16: 16851
properties from relativistic motions of charges and isotropic media, 16: 17009
ELECTROMAGNETIC WAVES
propagation in ionized gases, effects of collisions and oscillations of free electrons, 16: 17179 (RADC-TN-61-99)
propagation in plasma with nonlinear conductivity, 16: 17199
ELECTRON BEAMS
calibration of absorbed dose in water, 16: 16555
current modulation decay near 0°K, space-charge wave Landau damping in, 16: 16843
interactions with plasma, 16: 17178 (ML-793)
movement from high-vacuum to high-pressure stages, design of dynamic pressure stages for, 16: 16813 (UTIA-78)
radiation damage studies of metals with, 16: 16795
separation of different energies, magnetic device, 16: 17173(P)
time-of-flight measurements in plasma, 16: 17203
trapping in magnetic field, apparatus, 16: 17220(P)
ELECTRON-DIFFRACTION ANALYSIS
crystal contamination from, reduction, 16: 16841
ELECTRON MICROSCOPES
image contrast in, theory, 16: 16866
ELECTRON PAIRS
production by interactions of mesons (π^-) at 16 Bev, 16: 16935 (NP-11592(Vol.I)(p.79-83))
ELECTRON SCATTERING CROSS SECTIONS
calculation, 16: 16866
ELECTRON SOURCES
design for use in studies of radioinduced free radicals, 16: 16781 (WADD-TN-60-251)
dose distribution for food irradiation facility, homogeneous, 16: 16624
ELECTRONIC EQUIPMENT
design of demagnetization device, 16: 16485(P)
development and testing of high-temperature, radiation-tolerant, 16: 16777 (DC-58-4-71)
development for use in physics research, 16: 16811(R) (PR-P-52)
ELECTRONS
absorption in water, 16: 16555
capture by alpha particles in hydrogen, cross sections for, 16: 17035
charge transfer collision cross sections in gases, near-adiabatic criterion in, 16: 16868
density in plasma, measurement with optical maser beam, 16: 17191
energy distribution in plasma, measurement corrections for Langmuir probe method, 16: 16553
interactions with protons, proton form factors from, 16: 16942 (NP-11592(Vol.I)(p.139-40))
interactions with positrons, research on production of collisions at 500 Mev and 1 Bev c.m. energy, 16: 16992 (NP-11592(Vol.I)(p.487-501))
mobility measurements in plasma according to resistance variation in a magnetic field, 16: 17205
oscillations in accelerators, measurement of betatron and synchrotron, 16: 17171
propagation in static ion background along magnetic field, 16: 17200
reactions with cesium, elastic scattering and momentum transfer cross sections, 16: 16800(R) (AD-266440)
scattering by calcium-40, proton emission in, 16: 17095
scattering by nuclei at 300 to 1000 Mev, proton emission and angular and energy correlations, 16: 17094
scattering of 8.12 Bev mesons (μ), 16: 16945 (NP-11592(Vol.I)(p.147-50))
temperature in plasma, measurement with optical maser beam, 16: 17191
ELECTROSTATIC PRECIPITATORS
design for detection of fission products in gases, 16: 16566(P)
ELEMENTARY PARTICLES
Cayley octonions and strong interactions, 16: 16948 (NP-11592(Vol.I)(p.169-70))
collision of strongly interacting at energies above 10 Bev, analysis, 16: 17001 (NP-11592(Vol.II)(p.125-39))
conference on interactions, 16: 16925 (NP-11592(Vol.I))
conference on properties and theory, 16: 16993 (NP-11592(Vol.II))
dispersive bonding theory, 16: 17031
interactions at energies above 10 Bev, review, 16: 17000 (NP-11592 (Vol.II)(p.103-24))
interactions at high energies, relativistic coupling theory for, 16: 17013
interactions, derivation of new symmetries, 16: 17127
interactions, effective radii in strong, 16: 16923 (JINR-E-859)
interactions, final-state enhancement factors for scattering, 16: 17027
interactions, interference between the amplitudes of inelastic, 16: 17055
interactions of N-particle system at low density, strong, 16: 17063 (CEA-2086)
interactions of two-ingoing and two-outgoing, singularities of partial wave amplitudes, 16: 16970 (NP-11592(Vol.I)(p.337-42))
interactions, properties of n-particle systems in common potentials with, 16: 17112
interactions, S-matrix redundant pole properties in, 16: 17045
model for interactions and properties, field theoretical, 16: 16949 (NP-11592(Vol.I)(p.171-81))
reaction amplitudes and scattering in unphysical Riemann sheets, 16: 16968 (NP-11592(Vol.I)(p.327-30))
reactions with nuclei, 16: 17123
scattering amplitudes, analyticity of general unitarity term of three-momentum transfers, 16: 17019
scattering dispersion relations and stability conditions, 16: 17023
spin Hamiltonian, eigenvalues and induced transition probabilities for anistropic, 16: 16516 (AFOSR-1794(p.1-14))
unitary symmetry consequences, 16: 17030
ELEMENTS
solar system formation time, calculation using nucleosynthesis, 16: 16901
spectra for seventy, tables of line intensities by wavelength from 2000 to 9000 A, 16: 16337 (NBS-MON-32(Pt.II))
EMBRYOS
radiation effects on mammalian, 16: 16212
radiation effects on development and nervous system, 16: 16270
radiation injuries, protective effects of injections of whole cells, 16: 16289
ENTOMOLOGY
conference on radiation and radioisotopes in, Bombay, Dec. 1960, 16: 16108
radiation sources and radioisotopes in, in Pakistan, 16: 16130
research using radiation and radioisotopes in France and associated countries, 16: 16132
ENZYMES
radiation effects, gamma, heavy ion, and x, 16: 16189
radiosensitivity of thymus and liver nuclei, 16: 16219
ERBIUM
crystal spin-screw structure, magnetic field effects, 16: 16829
nuclear magnetic moments, spin-orbit coupling, and hyperfine fields, 16: 16831
photon reactions at 8 to 19 Mev, cross sections and neutron yield for, 16: 17083
ERBIUM ISOTOPES Er-166
decay, effects of paramagnetism on angular correlation of gamma–gamma cascades in, 16: 17155
energy level at 80 kev, hyperfine structure splitting, 16: 17136
excited state spectrum, first, 16: 17108

nuclear magnetic moments, 16: 17155

ERBIUM ISOTOPES Er-167

spin, 16: 17128

ERBIUM OXIDES

thermal expansion coefficients at 25 to 1000°C, 16: 16715(R) (CAL-PI-1273-M-10)

ERYTHROCYTES

radioactivity ratio with blood plasma, use in diagnosis of thyroid toxicosis, 16: 16169

ERYTHROPOIETIN

separation from blood plasma by ion exchange, 16: 16164(P)

ESCHERICHIA COLI

chemical protection against toxic effects of nitrogen mustard and radiation, 16: 16297

radiosensitivity, effects of strain, 16: 16206

ETHANE

yield in gamma radiolysis of liquid cyclopentane with ethylene scavenger, 16: 16424

ETHANE, BROMO-

quenching properties for use in Geiger counters, 16: 16101

radiolysis, 16: 16339(R) (TID-15369)

Szilard–Chalmers reaction, yields in, 16: 16422

ETHANE, CHLORO-

radiolysis, 16: 16339(R) (TID-15369)

ETHANE, HEXABROMO-

radiolysis by neutrons and gamma radiation, 16: 16339(R) (TID-15369)

ETHANE, IODO-

radiolysis, 16: 16339(R) (TID-15369)

ETHANE, TETRABROMO-

reactions with iodide in methanol, secondary isotope rate effect in, 16: 16376

ETHANETHIOL, 2-AMINO-

protective effects against radiation injuries and nitrogen mustard in *E. coli*, 16: 16297

protective effects against radiation injuries, 16: 16299

radioprotective effects combined with histamine or tryptamine, 16: 16296

ETHANOL

phosphorescence in liquid scintillation counting, 16: 16095

reactions with iodine, free radicals produced in, 16: 16339(R) (TID-15369)

ETHANOL–WATER SYSTEMS

pressure drop in, effects of test-section geometry, 16: 17291(R) (EURAEC-222)

ETHERS

ionization potentials, effects of substitution, 16: 16406 (NP-11495)

radiation effects on bis (phenoxyphenyl), 16: 16780 (NARF-62-3T)

ETHYL, 2-CARBOXY-

electron spin resonance spectrum in gamma-irradiated alpha alanine at 100 to 200°K, 16: 16429

ETHYL ETHER

quenching properties for use in Geiger counters, 16: 16101

reactions with iodine, free radicals produced in, 16: 16339(R) (TID-15369)

solvent properties for uranyl nitrates, 16: 16462

solvent properties for uranyl nitrates, 16: 16461

ETHYLAMINE

quenching properties for use in Geiger counters, 16: 16101

ETHYLAMINE, 2,2′-DITHIOBIS-

protective effects against urinary excretion of desoxycytidine in irradiated animals, 16: 16293

ETHYLENE

scavenger effects on gamma radiolysis of liquid cyclopentane, 16: 16424

ETHYLENE, CHLORO- POLYMERS

radiation effects on cleavage and dielectric constant, 16: 16428

ETHYLENE POLYMERS

aging and stress relaxation, effects of antimony oxide and chlorinated paraffin, 16: 16707(R) (AD-265319)

neutron reactions in, cross sections and spatial distributions, 16: 17059

radioinduced graft polymerization of vinyl monomers on, 16: 16449(P)

EUROPIUM

magnetic structure at 20 to 295°K, 16: 16836

nuclear magnetic moments, spin-orbit coupling, and hyperfine fields, 16: 16831

separation from cadmium by coprecipitation with cadmium–cerium alloy, 16: 16464

EUROPIUM FERRATES

magnetic properties of samarium-152 in, 16: 16832

EUROPIUM ISOTOPES Eu-146

isomers, existence of new short-period metastable, 16: 17147

EUROPIUM ISOTOPES Eu-152

decay scheme, 16: 17097

EUXENITES

analysis for niobium and tantalum by ion exchange, 16: 16312

EVAPORATORS

design for radioactive liquids, 16: 17335

EXPERIMENTAL BOILING WATER REACTOR

fuel element design and performance, review, 16: 16669

EXPERIMENTAL BREEDER REACTOR

fuel element design and performance, review, 16: 16669

EXPLODING WIRE PHENOMENA

dwell time relation to diameter and pressure, 16: 16844

propulsion by, development and instrumentation of device for, 16: 17314(R) (AD-266439)

EXPLOSIONS

analysis of 1908 occurrence in the Tunguska Taiga, 16: 16032(T) (JPRS-13480)

EXPLOSIVES

use for separating casing members, 16: 16494(P)

EXPONENTIAL PILES

reactivity changes in, long term, 16: 17244

EYES

radiation effects on electroretinal response in frogs, 16: 16259

radiation effects, review, 16: 16174 (ASD-TR-61-195)

radiation effects on retinal changes in rabbits, 16: 16175 (ASD-TR-61-415)

radiation effects in Macaca mulatta primates at 910 and 730 Mev, alpha and proton, 16: 16193

F

FALL-OUT

contamination of ship surfaces, simulated, 16: 16611 (USNRDL-TR-549)

decontamination of fixed military facilities during cold weather, 16: 16607 (NDL-TR-24)

distribution patterns from megaton thermonuclear explosions, 16: 16596 (CDRP-182-101)

monitoring data from fall 1961 USSR tests by rainfall analyses, 16: 16606 (HASL-121)

monitoring in atmosphere in Antarctica and between 60°N and 70°S, 16: 16042

monitoring in Canada, 1960, 16: 16598 (CNHW(RP-4))

monitoring of environmental levels, Public Health Service data for Jan. 1962, 16: 16619

FAST NEUTRONS

dosimetry at surfaces of biological shield of TRIGA Mark II Research Reactor, 16: 17310 (ORNL-TM-178)

reactions in plexiglass, polyethylene, and water, cross sections and spatial distributions, 16: 17059

FAST REACTORS

characteristics of BR-5, 16: 17247

FELDSPARS

formation of barium, lead, and strontium, in clay sulfate mixtures, 16: 16578

FERMIONS

interactions of highly relativistic, model, 16: 16950 (NP-11592(Vol.I) (p.191-5))

FERROMAGNETIC MATERIALS

demagnetization, device, 16: 16485(P)

theory, 16: 16873

thermodynamic properties, study of spin ½ atomic chains, 16: 16802 (AFOSR-1934)

FETUSES

radiation effects on subsequent behavior and learning ability, 16: 16221

radiation effects on behavior development, 16: 16272

FIBRINOGEN
separation of thermostabile glycoprotein from, 16: 16104 (PAN-252/X)
FIELD THEORY
approximation methods, superconductivity Hamiltonian role in, 16: 16850
canonical commutation relations for vector fields, 16: 17017
correspondence principle in indefinite-metric, 16: 17046
correspondence theorem for bare mesons, 16: 17041
elementary particle model, 16: 16949 (NP-11592(Vol.I)(p.171-81))
gauge transformations for vector meson fields, 16: 17018
model for highly relativistic interactions, 16: 16950 (NP-11592(Vol.I)(p.191-5))
of gravitational waves, invariant formulation, 16: 17225
propagator singularities in, 16: 16876
properties of a solution of the low equation for a local model, 16: 17224
quantum, analyticity and unitarity of S-matrix singularity structures, 16: 17021
quantum, models of local non-causal current operators in S-matrix theories, 16: 17022
S-matrix redundant pole properties, 16: 17045
FINNED TUBES
fabrication of helically, for use as heat exchangers, 16: 16704(P)
FISSION
energy from, review, 16: 16655
mass relation to yield at low energies, 16: 17126
FISSION PRODUCTS
determination in gases, precipitation chamber for, 16: 16566(P)
diffusion of gaseous in uranium dioxide, 16: 16650(R) (EURAEC-194 (App.7))
effects on aluminum and platinum films, 16: 16787
processing for cesium-137 and strontium-90 separation, 16: 17336
processing for cesium separation, 16: 17337
re-solution of gaseous, during post-irradiation heat treatment of uranium, 16: 16755
separation from thorium and uranium, carrier-free, 16: 16441
separation from uranium using alumina, 16: 16459
separation from uranium, 16: 16471(P)
FISSIONABLE MATERIAL
radiation effects, review, 16: 16663
FLOWMETERS
description of hinged-gate and radioactive-source system, 16: 16073
FLUID FLOW
distribution, effects of body intersecting flow channels, 16: 16500 (DC-59-11-57)
vaporization in steam-water system, growing-bubble model for, 16: 16504(R) (TID-15429)
FLUID FLOW (TURBULENT)
heat and momentum transfer in convective and shearing flows, 16: 16910
FLUID FUEL REACTORS
design of valve for discharging fuel from pebble-bed, 16: 17280(P)
design using fueled Raschig rings, 16: 17264(P)
design with uranium dioxide-alkali metal slurry, 16: 17281(P)
fuel evaluation, review, 16: 16671
hydrodynamic analysis of Fireball, 16: 17292 (FXM-428)
FLUIDS
oscillations of self-gravitating, 16: 16900
FLUORIDE VOLATILITY PROCESSES
corrosion studies, 16: 17229(R) (BMI-1565(Del.))
development, 16: 16464
FLUORIDES
metallurgical effects on irradiation failure of defected Zircaloy-2 clad uranium(IV) oxide fuel elements, 16: 16776 (CRFD-1067)
reactions with uranium hexafluoride, 16: 16334 (CEA-2110)
FLUORINE ISOTOPES F-17
energy levels, calculation of single-particle, 16: 17152
FLUORINE ISOTOPES F-18
distribution in rat tissues, 16: 16167
FLUORINE ISOTOPES F-19
gamma reactions (γ,p) energy distribution, 16: 17137
proton reactions at 143 Mev, gamma emission in, 16: 17088
reactions with aluminum, magnesium, and silicon at 26 Mev, 16: 16811(R) (PR-P-52)
triton reactions (t,p) at 5.74 Mev, energy levels from, 16: 17092
FLUORINE ISOTOPES F-20
beta decay, beta-gamma correlation, 16: 17144
energy levels, parity and spin of ground state, 16: 17144
FLUORINE ISOTOPES F-21
energy levels, 16: 17092
FONTENAY-AUX-ROSES REACTORS (TRITON)
radiolysis in, determination by measurement of formation and distribution of gases and hydrogen peroxide, 16: 16332 (CEA-2088)
FOOD
decontamination in nuclear war, 16: 16591 (AD-264822)
radioactivity, physiological effects of large and small amounts, 16: 16617
radiosterilization, vitamin sensitivity to radiation effects in, 16: 16623
radiosterilization and storage of grains, 16: 16126
FOOD IRRADIATION FACILITIES
dose distribution for, homogeneous, 16: 16624
FORMYL
electron spin resonance and structure of labeled and unlabeled, 16: 16359
FREE RADICALS
determination, in irradiated amino acid solutions, 16: 16434
electron absorption spectra of CO_2^- in gamma-irradiated sodium formate, 16: 16430
electron spin resonance spectra of alkyl, in gamma irradiated alkyl halides, 16: 16438
ionization potential of cyclic amine and cycloalkyl, 16: 16406 (NP-11495)
production in irradiation of gases, design of electron gun-molecular beam device for studying, 16: 16781 (WADD-TN-60-251)
production in Szilard–Chalmers reaction in bromoethane, 16: 16422
spectra of CO_2^- , in irradiated formates and oxalates, 16: 16435
FRETTING-CORROSION INHIBITORS
additive effects on oils, tracer studies, 16: 16064
FROGS
radiation effects on nerve-muscle preparation response to electric stimuli, 16: 16257
radiation effects on electroretinal responses of eye, 16: 16259
FUEL CELLS
development, 16: 16710(R) (AD-267028)
FUNGI
radiation effects on mutations and physiological injuries in *Neurospora crassa* in lower belt, cosmic, 16: 16191
FUSED SALTS
gamma absorption, correlation with Z number, 16: 16342(T) (FTD-TT-62-46)

G

GADOLINIUM
magnetization and volume magnetostriction at 280 to 380°K, 16: 16873
nuclear magnetic moments, spin-orbit coupling, and hyperfine fields, 16: 16831
separation from cadmium by coprecipitation with cadmium–cerium alloy, 16: 16464
GADOLINIUM COMPOUNDS
spectral analysis of salts by electrostatic matrices, 16: 16356
GADOLINIUM IONS
paramagnetic resonance of trivalent, in sulfate octohydrates of neodymium, samarium, and yttrium at zero field, 16: 16384
GADOLINIUM ISOTOPES Gd-154
energy levels, 16: 17081
excited state spectrum, first, 16: 17108
GADOLINIUM ISOTOPES Gd-158
isomers, existence of new short-period metastable, 16: 17147
GADOLINIUM RUTHENATES
magnetic susceptibility at 2 to 1300°K, 16: 16837
GADOLINIUM SULFATES
energy level splitting of octohydrate, ground state, 16: 16384
GADOLINIUM SULFIDES
thermal properties of semiconducting at 800°K, 16: 16799(R) (AD-265462)
GALLIUM COMPLEXES
with ethylenediaminetetra and n-hydroxyethylethylenediamine tri-acetate in water, isotope exchange between gallium ion and, 16: 16363

GALLIUM IONS
isotope exchange with gallium ethylenediaminetetra- and triacetic acid complexes in water, 16: 16363
GALLIUM–IRON ALLOYS
phase studies of nitrogen containing, 16: 16768
GALLIUM ISOTOPES
exchange between gallium ion and ethylenediaminetetra- and triacetic acid complexes in water, 16: 16363
GALLIUM ISOTOPES Ga-66
beta decay, polarization of positrons from, 16: 16059
GALLIUM ISOTOPES Ga-72
gamma spectra of metastable, at 100 kev, 16: 17313
GALLIUM–MANGANESE ALLOYS
phase studies of nitrogen containing, 16: 16768
GALLIUM–NICKEL ALLOYS
phase studies of nitrogen containing, 16: 16768
GALLIUM–VANADIUM ALLOYS
superconductivity, 16: 16830
GAMMA RADIATION
absorption by fused salts, correlation with Z number, 16: 16342(T) (FTD-TT-62-46)
angular correlation measurements, data recording system for, 16: 16636
angular distributions from proton capture (p,γ) by deuterium at 0.275 to 1.75 Mev, 16: 17010
biological effects on aging and behavior of mice, 16: 16269
biological effects on bacteria, DNA, eggs, enzymes, mammalian cells, virus, and yeast, 16: 16189
branching ratios in lead-205 level decay, 16: 17096
branching ratios in samarium-152 level decay, 16: 17097
coincidence counting, time-to-height pulse converter for, 16: 16547
detection and measurement, performance of semiconductor detectors in radiodiagnosis, 16: 16556
detection and measurement, performance of sodium iodide crystals, 16: 16135
detection and measurement in man, whole-body counting, 16: 16136
detection and measurement, in man, whole-body counting, 16: 16137
detection and measurement in man, whole-body counting, 16: 16138
detection and measurement of internally deposited in man, 16: 16142
detection and measurement in man, whole-body counting, 16: 16143
detection and measurement in man, whole-body counting, 16: 16145
dosage determination during zero-power reactor incident, 16: 16618
dosimetry at surfaces of biological shield of TRIGA Mark II Research Reactor, 16: 17310 (ORNL-TM-178)
effects on bones, external high-level exposure, 16: 16194
effects on eggs and larvae of Mexican fruit-fly in grapefruit, 16: 16123
effects on fat-soluble vitamins, 16: 16623
effects on fertility and survival of grain weevil, continuous and fractionated dose, 16: 16125
effects on insects, control and eradication, 16: 16127
emission in iodine-131, properties, 16: 17117
emission in proton reactions with fluorine-19 and oxygen-16, 16: 17088
energies, comparison methods, 16: 16811(R) (PR-P-52)
neurological effects on response of visual cortex in cats, 16: 16263
neurological effects on neurosecretory activity of neurons of supra-optic and paraventricular nuclei in rats, 16: 16278
neurological effects, comparison of response variability and degree of higher activity of nervous system, 16: 16283
penetration of walls of cylindrical and conical collimating holes, 16: 16217
polarization in niobium-95 beta decay, circular, 16: 17085
reactions with hydrogen, attempts at detection of mesons (ω^0) produced in, 16: 17065 (CTSL-32)
reactions with nuclei, theory of deuteron production in, 16: 17071 (NP-11564)
secondary effects in therapeutic irradiation of thorax, 16: 16227
spectra from proton reactions (p,γ) with phosphorus-31 at 355 and 440 kev, 16: 17090
spectra from proton capture (p,γ) in magnesium-25 at 0.95 to 1.80 Mev, 16: 17103
GAMMA SHIELDING
calculation methods for accelerators, 16: 17161
GAMMA SOURCES
calibration of kilocurie cobalt-60, performance of ionization chamber, 16: 16554
design of cobalt-60 mobile, for treatment of infested fruits, 16: 16123
GAMMA SPECTRA
data processing, applications of computers, 16: 16154
data processing, storage, and retreival, 16: 16153
GAMMA SPECTROMETERS
calibration for whole-body counting, 16: 16139
data processing, applications of computers, 16: 16154
data processing, storage, and retreival, 16: 16153
description for lunar surface composition analysis, 16: 16532
design and performance for whole-body counting, 16: 16141
performance for partial-body measurement of plutonium-239, 16: 16148
performance for whole-body counting, 16: 16159
performance for whole-body counting of man, 16: 16150
shielding for whole-body counting, 16: 16141
GAMMA SPECTROSCOPY
scintillation spectrograms evaluation, 16: 16533
GAS COOLED REACTORS
boiler calculations for, once-through, 16: 16509
corrosion problems survey, 16: 16036
design for storage of used fuel elements in shield, 16: 17273(P)
design with shield between ducts and core, 16: 17248(P)
development progress for civilian applications, 16: 17229(R) (BMI-1565(Del.))
fuel assembly design for suspension, 16: 17278(P)
fuel element canning materials for carbon dioxide, properties, 16: 17287 (CNI-102)
fuel element failure detection, precipitation chamber for, 16: 16566(P)
fuel element stability, 16: 17245
fuel plate assembly design for graphite-moderated, 16: 17272(P)
loading and unloading with water shielding, 16: 17261(P)
stability problems in graphite-moderated, using self-regulating absorbers, 16: 17302
GAS FLOW
measurement using hinged-gate and radioactive-source system, 16: 16073
pressure regulator for use at high pressures, 16: 16569(P)
GAS FLOW (TURBULENT)
in channels, analysis, 16: 16507(T) (UCRL-Trans-785(L))
GASEOUS DIFFUSION PROCESS
concentration transients control and simulation in, development of equipment for, 16: 16626 (CEA-2010)
GASEOUS IONS
interactions with beryllium and molybdenum, secondary ion emission, 16: 16880
GASES
analysis for fission products, precipitation chamber for, 16: 16566(P)
distribution and formation by radiolysis in Triton Reactor, 16: 16332 (CEA-2088)
dynamics of cosmic, review, 16: 16902
electromagnetic wave propagation in ionized, effects of collisions and oscillations of free electrons, 16: 17179 (RADC-TN-61-99)
emission spectra at high pressures and temperatures, 16: 16819
ionization equilibrium equations for monatomic mixtures, 16: 16818
irreversible processes in ionized, 16: 16820
radiation effects, design of electron gun-molecular beam device for studying, 16: 16781 (WADD-TN-60-251)
re-solution of fission, during post-irradiation heat treatment of uranium, 16: 16755
reactions with graphite and other carbons, 16: 16338 (NPCC/MWP(G) P180)
virial coefficient for hard-sphere, calculation and consistency of fifth, 16: 16847
GEIGER-MUELLER TUBES
correction factors for end-window, for absolute beta counting, 16: 16545
design for low-level tritium counting, 16: 16099
performance, in whole-body counters, 16: 16155
quenching gases for, for measurement of natural tritium levels, 16: 16101
GENETICS
mutations in Drosophila, 16: 16203

mutations induced by exposure to ultraviolet radiation, in Drosophila, 16: 16201
radiation effects on human populations, 16: 16225
radioinduced in Drosophila, 16: 16204
radioinduced mutations in Drosophila, 16: 16202

GEOLOGY
survey of tritium studies in United States, 16: 16081

GEOMAGNETIC FIELDS
measurements during IGY, survey, 16: 16817

GEOPHYSICS
measurements during IGY, survey, 16: 16817

GERMANIUM
diffusion and solubility of elements in, tracer study at 700 to 930°C, 16: 16057
radiation effects of thermal neutrons, radiation doping, 16: 16056

GERMANIUM CHLORIDES
exchange reactions with chlorine in gas chromatography, 16: 16371

GERMANIUM–IRON ALLOYS
phase studies of nitrogen containing, 16: 16768

GERMANIUM ISOTOPES Ge-72
energy levels, 16: 17081

GERMANIUM ISOTOPES Ge-74
energy levels, 16: 17081

GERMANIUM–MANGANESE ALLOYS
phase studies of nitrogen containing, 16: 16768

GERMANIUM–NICKEL ALLOYS
phase studies of nitrogen containing, 16: 16768

GLASS
coating with aluminum oxide by flame spraying, 16: 16641 (ARL-59)
preparation and scintillation properties of cerium-containing, 16: 16892(P)
preparation and scintillation properties of cerium oxide-containing, 16: 16894(P)
sorption of helium and nitrogen on Vycor porous, 16: 16385
sorptive properties for protactinium, 16: 16388

GLUCOSE
analysis for sulfur-35 by liquid scintillation, 16: 16091
analysis for tritium by liquid scintillation, 16: 16091
diffusion of carbon-14 labeled, into central nervous system in cockroach, 16: 16117

GLUTAMIC ACID
determination in protein hydrolyzates using carbon-14 or tritium labeled 1-fluoro-2,4-dinitrobenzene, 16: 16089

GLUTATHIONE
protective effects against radiation injuries and nitrogen mustard in *E. coli*, 16: 16297

GLYCINE
determination in protein hydrolyzates using carbon-14 or tritium labeled 1-fluoro-2,4-dinitrobenzene, 16: 16089

GLYCOGEN
radiation effects on appearance in rat brains, 16: 16275

GLYCOLS
diphenylethylene-, analysis for carbon-14 by liquid scintillation, 16: 16091

GOLD
characteristics as radiation target, incorporated into nuclear emulsion, 16: 16967 (NP-11592(Vol.I)(p.307-25))
electron scattering cross sections, 16: 16866
neutron attenuation, 16: 17237 (NASA-TN-D-1184)
neutron self-shielding effect in activation, formula for measuring, 16: 16415
x-ray emission spectra, 16: 16867

GOLD FILMS
thickness measurement during vacuum deposition, radioactive technique for continuous, 16: 16622

GOLD ISOTOPES Au-197
neutron capture cross sections 0.001 to 1 Mev, statistical theory, 16: 17070 (NDA-2093-7)
neutron capture, rate measurements, 16: 17233 (CRRP-985-D)
resonance neutron activation cross section, 16: 17072 (PNE-113P)

GOLD ISOTOPES Au-198
beta decay, dependence of beta–gamma correlations on electron velocity, 16: 17142
pathological effects in brain, 16: 16251
use as gamma source in irradiation of brain tumors, 16: 16245

GOLD–MANGANESE ALLOYS
crystal spin-screw structure, magnetic field effects, 16: 16829

GOODYEAR ATOMIC CORP., PORTSMOUTH, OHIO
health and safety activities, 1961, 16: 16605 (GAT-R-281)

GRAPHITE
coating with carbides and metallic compounds for impermeability, 16: 17263(P)
energy storage in irradiated, apparatus for differential thermal analysis, 16: 16522 (CEA-2094)
erosion by gases at 3000°K, 16: 16726(R) (NP-11311)
oxidation in air and carbon dioxide, effects of impurities, 16: 16331 (CEA-1934)
physical properties of pyrolytic, structure effects on, 16: 16760
polishing and preparation for metallographic studies, 16: 16761
porosity measurements, development of mercury porosimeter for, 16: 16521 (CEA-2093)
production and properties, survey, 16: 16036
properties as reactor moderator, 16: 16764
purification, 16: 16465(P)
radiation effects of fast neutrons, 16: 16036
radiation effects in carbon dioxide systems, 16: 16407 (NPCC/MWP(G)/P157)
reactions with carbon dioxide under irradiation, theory, 16: 16408 (NPCC/MWP(G)/P161)
reactions with hydrogen at 1800 to 2500°C, 16: 16726(R) (NP-11311)
reactions with oxidizing gases, 16: 16338 (NPCC/MWP(G)P180)
thermal conductivity at 1000 to 2400°K, 16: 16726(R) (NP-11311)
uranium vapor transport from compacts with uranium carbide, 16: 16721 (GAMD-1233)

GRAPHITE BROMIDES
thermal expansion at 0 to 700°C, 16: 16763

GRAPHITE CRYSTALS
elastic constants at 600 to 1800°C, 16: 16726(R) (NP-11311)

GRAPHITE MODERATED REACTORS
core structure design for accommodating irradiation growth, 16: 17267(P)
design for storage of used fuel elements in shield, 16: 17273(P)
fuel plate assembly design for gas-cooled, 16: 17272(P)
stability problems in gas-cooled, using self-regulating absorbers, 16: 17302

GRAPHITE–URANIUM SYSTEMS
reactivity changes in, long term, 16: 17244

GRASSHOPPERS
phosphorus-32 decay, distribution, and persistence in, 16: 16119

GRAVITATION
invariant formulation, 16: 17225
propagation in electrically conducting fluids, magnetic-field effects on, 16: 16899
wave spectrum, model for atmospheric, 16: 16580

GREAT BRITAIN
tritium content in atmospheric methane over, 1957 to 1959, 16: 16079

GREENLAND
geologic history, 16: 16577 (TID-14861(Vols.I&II))

GROUND
surface motion measurements for Project Gnome, 16: 16528 (VUP-2202)

GROUND WATERS
analysis for carbon dioxide and residual gases in geothermal, in New Zealand, mass spectrometric, 16: 16581
analysis for carbon-13/12 ratio in geothermal, in New Zealand, 16: 16582
analysis for tritium, geophysics, 16: 16077
analysis for tritium in New Zealand, 1956 to 1960, 16: 16078
flow in oil fields, tracer studies, 16: 16074
flow velocity, tracer studies, 16: 17332(R) (EURAEC-25)

GUIDED MISSILES
materials, properties of elastomers as, 16: 16302 (ASD-TR-61-234)

GUINEA PIGS
radiation effects on central nervous system, 16: 16277

H

HAFNIUM
corrosion by cesium at 1600 to 2500°F, 16: 16684 (TID-7626(Pt.I)(p.109-10))
HAFNIUM BORIDES
thermodynamic properties and vaporization behavior at 2175 to 2500°K, 16: 16722 (LA-2611)
HAFNIUM ISOTOPES Hf-172
electron capture decay, 16: 17111
HAFNIUM ISOTOPES Hf-173
decay, 16: 17110
HAFNIUM ISOTOPES Hf-177
energy levels, 16: 17093
HAFNIUM–NIOBIUM–VANADIUM ALLOYS
fabrication and tensile properties, effects of nitrogen and oxygen on, 16: 16712(R) (ARF-2231-3)
HAFNIUM–RHENIUM ALLOYS
phase studies, 16: 16724(R) (NMI-9238)
HALL EFFECT
relation to tensor conductivity effects in magnetohydrodynamics, 16: 17188
HALOÖRGANIC COMPOUNDS
radioinduced reactions of unsaturated, with hydrogen sulfide or mercaptan, 16: 16451(P)
synthesis of halogenated fluorinated β-diketones for metal extraction, 16: 16401(P)
HANDBOOKS AND MANUALS
on HTRE-1 reactor assembly and auxiliary systems maintenance, 16: 17289 (DC-55-11-25)
on properties of elastomers for use on aerospace weapons systems, 16: 16302 (ASD-TR-61-234)
HANDS
exposure time in glove boxes, motion picture analysis, 16: 16616
HEALTH PHYSICS
in uranium mines, 16: 16592 (AEET/HP/SM-4)
HEART
radiation effects from esophagus cancer therapy, 16: 16208
radiation effects on Purkinje fibers in calves and sheep, 16: 16279
HEAT EXCHANGERS
fabrication of helically finned tubing for use as, 16: 16704(P)
tubes, fabrication of two-walled, 16: 16489(P)
vibration behavior, theory of acoustic, 16: 16505 (TIM-280)
HEAT EXCHANGERS (GAS-GAS)
design, effects of para-ortho shift on size in hydrogen–nitrogen heat exchange, 16: 16506 (WADD-TN-60-238)
HEAT TRANSFER
analysis of phenomena at moment of heating, 16: 16501 (EURAEC-147)
at interface of two metals in contact, 16: 16476(R) (NYO-9457)
burnout, analysis for uniformly heated water channels, 16: 17226 (AEEW-R-117)
burnout in steam-water systems, analysis, 16: 16499 (CEA-Bib-28)
in nucleate pool boiling, 16: 16503 (NP-11491)
profiling along reactor cooling channel length, 16: 16511
HEAT TRANSFER SYSTEMS
reassembly and testing at Piacenza Power Station, 16: 17291(R) (EURAEC-222)
HEATERS
development and evaluation of tantalum carbide-coated graphite, 16: 16572 (ASD-TR-61-74)
HEAVY WATER REACTORS
design of sodium-cooled, with barrier system, 16: 17266(P)
development of JRR-3, 16: 17308 (JAERI-5008)
operation for longer core life, 16: 17251(P)
reactivity and void coefficients of uranium(IV) oxide rod lattices, 16: 17241(R) (UNC-5005)
reactivity control, 16: 17269(P)
HELIUM
abundance in high-velocity A stars, ratio to hydrogen, 16: 16896
conversion to carbon and oxygen in Population II stars, 16: 16915
detection in minerals and rocks, 16: 16577 (TID-14861(Vols.I&II))
dielectric breakdown using secondary electrons at 10^{-4} mm mercury, 16: 16801 (AFCRL-62-239)
electron transfer collisions near adiabatic conditions with hydrogen atoms and ions, 16: 16868
expansion in red giant stars, 16: 16914
plasma generation and acceleration by stationary field induction coil, 16: 17321
positronium elastic scattering at low energy, 16: 16870
reactions with lithium, energy curves for, 16: 16353
sorption on Vycor porous glass at 1.7 to 4.22°K, 16: 16385
spectra in nebulae, optical depth effects, 16: 16895
HELIUM (LIQUID)
meson (μ) capture rate, 16: 16943 (NP-11592(Vol.I)(p.141))
neutron scattering, spectrum of density fluctuations by excitation in, 16: 17061 (AROD-431:45)
HELIUM–HYDROGEN SYSTEMS
electron transfer collisions near adiabatic conditions, 16: 16868
ionization equilibrium equations, 16: 16818
HELIUM IONS
collision cross sections, effect of Coulomb repulsion on, 16: 16869
electron transfer collisions near adiabatic conditions with argon and neon, 16: 16868
interactions with beryllium and molybdenum, secondary ion emission, 16: 16880
HELIUM ISOTOPES (LIQUID)
thermodynamic properties of 3-4 mixtures, 16: 16865
HELIUM ISOTOPES He-3 (LIQUID)
transition to the superfluid state, 16: 16888
HELIUM ISOTOPES He-4
gamma reactions (γ,np), 16: 17149
hyperon (Λ) binding energies in $({}_{\Lambda}He^4)$, 16: 17015
HELIUM ISOTOPES He-5
hyperon (Λ) binding energies in $({}_{\Lambda}He^5)$, 16: 17015
HEPTENE
yields in gamma radiolysis of methylcyclohexane, 16: 16417
HEXANE
quenching properties for use in Geiger counters, 16: 16101
HIGH-ALTITUDE EXPLOSIONS
pressure pulses from, vertical temperature model from, 16: 16579
HIROSHIMA
genetic effects of radiation on population, 16: 16225
HISTAMINE
protective effects against radiation injuries and nitrogen mustard in *E. coli*, 16: 16297
radioprotective effects combined with mercamine or tryptamine, 16: 16296
HISTIDINE
determination in protein hydrolyzates using carbon-14 or tritium labeled 1-fluoro-2,4-dinitrobenzene, 16: 16089
HOLMIUM
crystal spin-screw structure, magnetic field effects, 16: 16829
photon reactions at 8 to 19 Mev, cross sections and neutron yield for, 16: 17083
solubility in cadmium(liquid), 16: 16464
HOLMIUM HYDRIDES
magnetic properties at 4 to 300°K, 16: 16840
HOLMIUM ISOTOPES Ho-165
nuclear magnetic moments, 16: 16831
HOLMIUM RUTHENATES
magnetic susceptibility at 2 to 1300°K, 16: 16837
HUMIDITY
measurements, development of aluminum oxide element for use in, 16: 16526 (SC-4667(RR))
HYDRAULIC FLUIDS
radiation effects on mix bis (phenoxylphenyl) ether, 16: 16780 (NARF-62-3T)
HYDROAROMATIC COMPOUNDS
free radical ionization potentials, 16: 16406 (NP-11495)
HYDROBROMIC ACID
reactions with uranium hexafluoride in gaseous phase, 16: 16403(P)
HYDROCARBONS
use as catalyst in thermonuclear reactions, 16: 17212(P)
HYDROCHLORIC ACID
activity coefficients in methanol–water mixture at 25°C, rule for calcula-

tion, 16: 16375
erosive effects on refractory materials at 3000°K, 16: 16726(R) (NP-11311)
oxidation-reduction potential of uranium(IV) –uranyl system in, effects of temperature on, 16: 16364
rotational states of molecules in rare gas crystals, 16: 16330 (AD-264708)
solvent properties for beryllium, 16: 16373
HYDRODYNAMICS
theory, differential solutions for pressure-compensated fields, 16: 16638
HYDROFLUORIC ACID
protective effects with chromium(VI) ions, on titanium, 16: 16464
reactions with uranyl fluorides and water, stability of hydrates and hydrofluorides from, 16: 16333 (CEA-2106)
HYDROFLUORIC ACID–NITRIC ACID SYSTEMS
corrosive effects on type 309SCb stainless steel, 16: 16464
HYDROGEN
abundance in high-velocity A stars, ratio to metals, 16: 16896
additive effects of adsorbed, on adsorption of sulfur on iron surfaces, 16: 16051
analysis for tritium, benzene liquid scintillator method for low-level, 16: 16097
determination in geothermal bores, fumaroles, and pools in New Zealand, mass spectrometric, 16: 16581
dielectric breakdown using secondary electrons at 10^{-6} mm mercury, 16: 16801 (AFCRL-62-239)
dissociation and ionization in high frequency discharges, 16: 16871
electric discharge ignition, application of law of similarity to, 16: 16883
electron capture by alpha particles in, cross sections for, 16: 17035
electron scattering cross sections, 16: 16866
electron transfer collisions near adiabatic conditions with gaseous atoms and ions, 16: 16868
electronic energy of molecular, 16: 16357
erosive effects on refractory materials at 3000°K, 16: 16726(R) (NP-11311)
exchange with tritium, thermodynamic isotope effects in, 16: 16088
gamma reactions, attempts at detection of mesons (ω^0) produced in, 16: 17065 (CTSL-32)
hypervirial average values for nonrelativistic and relativistic atomic, 16: 16815
isotope effect in iodide debromination of sym-tetrabromoethane, secondary, 16: 16376
isotope effects in radiolysis of organic compounds, 16: 16086
mesic atom (μ) processes in gaseous, experimental study, 16: 16884
neutron distributions in, fast, 16: 17059
ortho-para conversion, effects on heat exchanger size in hydrogen-nitrogen heat exchange, 16: 16506 (WADD-TN-60-238)
reactions with graphite and titanium carbide at 1800 to 2500°C, 16: 16726(R) (NP-11311)
Schmidt numbers for normal and para, 16: 16822
separation from tritium and tritium hydride by gas chromatography, 16: 16085
sintering effects on plutonium oxide–uranium oxide powder phase equilibria, 16: 16753
solubility in Zircaloy-2, Zircaloy-4, and zirconium at 400 to 520°C, 16: 16752
yield in radiolysis of liquid cyclohexane, mechanism of unimolecular, 16: 16426
yields in gamma radiolysis of methylcyclohexane, 16: 16417
yields in gamma radiolysis of methylcyclohexane, effects of benzene on, 16: 16418
HYDROGEN (LIQUID)
hazards of use in bubble chamber, research programs, 16: 16610(R) (TID-15422)
HYDROGEN IONS
electron transfer collisions near adiabatic conditions with gaseous atoms, ions, and molecules, 16: 16868
interactions with beryllium and molybdenum, secondary ion emission, 16: 16880
wave function for molecular, use of nonintegral exponents in elliptical coordinate, 16: 16845
HYDROGEN ISOTOPES H-4
hyperon (Λ) binding energies in (${}_{\Lambda}H^4$), 16: 17015
HYDROGEN–NEON SYSTEMS
electron transfer collisions near adiabatic conditions, 16: 16868
HYDROGEN PEROXIDES
distribution and formation by radiolysis in Triton Reactor, 16: 16332 (CEA-2088)
HYDROGEN SULFIDES
radioinduced reactions with halogenated unsaturated organic compounds, 16: 16451(P)
HYDROGEN TRITIDES
separation from hydrogen and tritium by gas chromatography, 16: 16085
HYDROGEN–ZIRCONIUM SYSTEMS
phase diagram at high hydrogen content, composition-pressure isotherms at 500 to 850°C, 16: 16754
HYDROXYL IONS
electronic energy of molecular, 16: 16357
HYPERFRAGMENTS
binding energies, 16: 17015
production by meson (K^-) interactions with emulsion nuclei at 800 Mev, 16: 16976 (NP-11592(Vol.I)(p.363-9))
HYPERONS
analysis of proof on Y isobar, 16: 16981 (NP-11592(Vol.I)(p.397-406))
interactions with mesons (π), resonance state, 16: 17032
parity, 16: 16980 (NP-11592(Vol.I)(p.389-94))
production by meson (π) interactions at 1.89 Bev, 16: 16977 (NP-11592 (Vol.I)(p.371-4))
resonances as unitary multiplets, 16: 17029
HYPERONS (Λ)
interactions with nucleons, binding energies, 16: 17015
parity in deuteron-hyperon (Σ^+) interactions below 5 Mev, 16: 17042
HYPERONS (Λ^0)
beta decay branching ratios, 16: 16951 (NP-11592(Vol.I)(p.197-200))
production in lead by 100-Mev mesons (K_2^0), 16: 17051
HYPERONS (Σ)
production in meson (K^-)-proton interactions at 1.1 to 1.4 Bev/c, parity relative to (Λ), 16: 17042
HYPERONS (Σ^-)
beta decay branching ratios, 16: 16951 (NP-11592(Vol.I)(p.197-200))
HYPERONS (Σ^0)
production in lead by 100-Mev mesons (K_2^0), 16: 17051
HYPERONS (Σ^+)
interactions with deuterons below 5 Mev, parity relative to (Λ) in, 16: 17042

I

ICE
thermal expansion between 18°K and melting point, 16: 16879
ICE-d_2
thermal expansion between 18°K and melting point, 16: 16879
IMMUNITY
immune reactions in radiation chimeras, 16: 16178 (USNRDL-TR-553)
reactions between bound antiserum and autologous antibodies, effects of irradiation, 16: 16195
IN-PILE LOOPS
design and performance of fast pneumatic transfer tube for irradiation of specimens, 16: 17313
development and operating conditions for determination of uranium dioxide fuel performance, 16: 17296(R) (GEAP-3771-2)
INCOMPRESSIBLE FLOW
magnetohydrodynamic, of conducting fluid in axisymmetric tubes, 16: 16854
magnetohydrodynamic boundary layer of conducting, past magnetized flat plate, 16: 16512
INDIAN OCEAN
silts accumulation rates in, thorium-230/thorium method for determination, 16: 16583
INDIUM
determination in iron meteorites by activation, cellulose acetate–dithizone columns for, 16: 16319
neutron self-shielding effect in activation, formula for measuring, 16: 16415

INDIUM–IRON ALLOYS
phase studies of nitrogen containing, 16: 16768
INDIUM ISOTOPES In-115
neutron capture cross sections 0.001 to 1 Mev, statistical theory, 16: 17070 (NDA-2093-7)
neutron capture, rate measurements, 16: 17233 (CRRP-985-D)
INDIUM–MANGANESE ALLOYS
phase studies of nitrogen containing, 16: 16768
INDIUM–NICKEL ALLOYS
phase studies of nitrogen containing, 16: 16768
INDOLE,3-(2-AMINOETHYL)-
protective effects of derivatives, against radiation injuries, 16: 16300
radio-protective effects combined with histamine, mercamine, or aminoethylisothiuronium, 16: 16296
INDOLES, 3–(2-AMINOETHYL)–
protective effects against radiation in mice, 16: 16200
5-INDOLOL, 3-(2-AMINOETHYL)-
content in brain of rats, radiation effects, 16: 16273
protective effects against radiation and nitrogen mustard in *Escherichia coli*, 16: 16297
protective effects against radiation injuries, 16: 16299
INDUSTRIAL HYGIENE
in uranium mines, 16: 16592 (AEET/HP/SM-4)
INFECTIONS
radiation effects on healing in rabbits, repeated, 16: 16211
radiation sickness effects on activation of latent dysentry in monkeys, 16: 16295
INITIAL ENGINE TEST
assembly and auxiliary systems maintenance, manual for, 16: 17289 (DC-55-11-25)
INSECTICIDES
metabolism in animals, mechanism of organophosphate, 16: 16113
metabolism of Dipterex in normal and resistant flies, 16: 16116
metabolism of labeled, in animals, 16: 16115
metabolism of phosphorus-32 labeled organophosphate, by plants, 16: 16112
toxic effects of chlorine-36 labeled Dieldrin in mice, 16: 16114
INSECTS
control in Philippines, future of radioisotopes in, 16: 16131
excretion and incorporation of labeled phosphate in aphids, 16: 16122
feeding behavior of phytophagous, use of radioisotopes in study, 16: 16121
labeling ants in pineapple plantations, methods for, 16: 16111
labeling with radioisotopes, research on, 16: 16109
labeling with radioisotopes for studies on crop protection, 16: 16110
metabolism of Dipterex in normal and resistant flies, 16: 16116
metabolism of organophosphorus insecticides in, mechanisms, 16: 16113
metabolism, technical problems of radioisotope measurement in, 16: 16120
permeability of perilemma in cockroach, study using carbon-14 labeled sugars, 16: 16117
phospholipid fractions in thoracic ganglion in Dieldrin resistant and susceptible houseflies, 16: 16118
phosphorus-32 decay, distribution, and persistence in Madeira cockroach, 16: 16119
radiation control and eradication, 16: 16127
radiation control, direct and indirect, 16: 16126
radiation control of *Dysdercus* in tropical countries, 16: 16128
radiation control, role of lethal mutants in, 16: 16129
radiation effects on eggs and larvae of Mexican fruit-fly in grapefruit, 16: 16123
radiation effects on fertility and survival of grain weevil, continuous and fractionated dose, 16: 16125
radiosensitivity of housefly pupae, effects on development and emergence mechanism, 16: 16124
INSTRUMENTATION
development of aluminum oxide humidity sensing element, 16: 16526 (SC-4667(RR))
INSTRUMENTS
design of signal recording and display arrangement for supervising nuclear power plants, 16: 16561(P)
INTERNAL COMBUSTION ENGINES
lubrication and wear in large diesel, tracer studies, 16: 16062
lubrication and wear, tracer studies, 16: 16063
INTESTINE
sensitivity to antibiotics in microfluora, strontium-90 carrier effects on seasonal fluctuations in, 16: 16210
IODIDE IONS
reactions with labeled and unlabeled sym-tetrabromoethane in methanol, secondary isotope rate effects in, 16: 16376
IODINE
reactions with ethanol, ethyl ether, and isopropanol, free radicals produced in, 16: 16339(R) (TID-15369)
reactions with propane in gaseous phase, photochemical, 16: 16339(R) (TID-15369)
removal from gases, 16: 17332(R) (EURAEC-25)
IODINE ISOTOPES I-131
decay scheme, gamma energies from, 16: 17117
determination in bulk milk samples, 16: 16594 (AEEW-R-138)
determination in man, whole-body counting, 16: 16158
determination in man, whole-body counting, 16: 16159
determination in man, whole-body counting, 16: 16161
determination in man, whole-body counting, 16: 16162
tracer studies with bromine-82 mixtures, 16: 16105
use in determination of thyroid uptake, 16: 16106
ION BEAMS
movement from high-vacuum to high-pressure stages, design of dynamic pressure stages for, 16: 16813 (UTIA-78)
reactions of heavy, on heavy and medium nuclei, 16: 17134
therapeutic applications of accelerated, 16: 16242
ION EXCHANGE MATERIALS
performance for water-*d*, purification in production reactors, 16: 16335(R) (DP-678)
performance of sulfosalicylic acid as complexing agent, 16: 16329
ION EXCHANGE PROCESSES
development, 16: 16464
ION SOURCES
design and performance for producing low-energy negative ion beams, 16: 16559
emission channel effects in, 16: 16814(T) (FTD-TT-62-435)
IONIZATION
Coulomb effects in collision, 16: 16869
IONIZATION CHAMBERS
design and performance for calibration of kilocurie gamma sources, 16: 16554
pulse analyzing circuit design and performance for gridded, 16: 16541
IONOSPHERE
book: *Radiowave Absorption in the Ionosphere*, 16: 16916
measurements by satellite, 16: 17316 (NASA-TN-D-414)
measurements during IGY, survey, 16: 16817
IONS
behavior of electron-induced negative, 16: 16409(R) (TID-15424)
capture and initial orbits in Karlsruhe cyclotron, 16: 17159(T) (UCRL-Trans-812)
collision cross sections, effect of Coulomb repulsion on, 16: 16869
heavy biological effects on bacteria, DNA, eggs, enzymes, mammalian cells, virus, and yeast, 16: 16189
heavy, effects on animal skin and tissues, 16: 16190
IRIDIUM FLUORIDES
physical properties, 16: 16464
IRIDIUM ISOTOPES Ir-192
decay, platinum-192 energy levels from, 16: 17116
IRIDIUM–TANTALUM ALLOYS
phase studies, 16: 16724(R) (NMI-9238)
IRON
abundance in high-velocity A stars, 16: 16896
adsorptive properties of hydrogen-supersaturated, for sulfur, 16: 16051
analysis for molybdenum and tin by solvent extraction with 8-quinolinol, spectrophotometric, 16: 16314
analysis for tantalum, spectrophotometric, 16: 16313
coating with aluminum oxide by flame spraying, 16: 16641 (ARL-59)
determination in uranium compounds, spectrographic, 16: 16304 (CNEN-96)
diffusion and solubility in germanium at 700 to 930°C, tracer study,

16: 16057
diffusion in copper and silver crystals, isotope effects, 16: 16047
distribution of antimony between liquid lead and solid or liquid, 16: 16053
electron scattering cross sections, 16: 16866
emission spectra at high temperatures, pressure effects on, 16: 16819
grain boundaries, effects of plastic deformation and recrystallization, 16: 16050
radiation damage assessment by nondestructive techniques, 16: 16791
radiation effects of neutrons, cold-working recovery of faults, 16: 16783
radiation effects on availability in soils, 16: 16176 (NP-11578)
reactions with phosphorus and sulfur compounds in oils, up to 700°C, 16: 16054
self-diffusion at 918 to 1260°C in volume and on surfaces of γ-phase, 16: 16049
solubility in lithium at high temperature, 16: 16689 (TID-7626(Pt.I)(p.143-5))

IRON(II) CHLORIDES
spectroscopy of iron(II) ions in, by neutron scattering, 16: 16824

IRON(II) IONS
spectroscopy in ferrous chloride by inelastic scattering of cold neutrons, 16: 16824

IRON(III) IONS
extinction coefficients in light and heavy water, 16: 16387

IRON ISOTOPES Fe-56
energy levels, 16: 17081

IRON ISOTOPES Fe-57
gamma, hyperfine spectra, and polarization, study by Mossbauer effect, 16: 16060

IRON ISOTOPES Fe-58
energy levels, 16: 17081
excited state spectrum, first, 16: 17108

IRON ISOTOPES Fe-59
determination in man, whole-body counting, 16: 16160
determination in man, whole-body counting, 16: 16158

IRON–NICKEL ALLOYS
radiation effects on structure, neutron, 16: 16782

IRON–NICKEL–URANIUM ALLOYS
phase studies, eutectic temperature and composition, 16: 17297(R) (LAMS-2681)

IRON–NIOBIUM ALLOYS
analysis for niobium and tantalum by ion exchange, 16: 16312

IRON–PALLADIUM ALLOYS
atomic magnetic moment of palladium in, 16: 16838
atomic magnetic properties, 16: 16839

IRON–RHODIUM ALLOYS
magnetic structure, temperature effects, 16: 16834

IRON–RUTHENIUM–URANIUM ALLOYS
phase studies, eutectic temperature and composition, 16: 17297(R) (LAMS-2681)

IRON–SILICON–URANIUM SYSTEMS
phase studies, eutectic temperature and composition, 16: 17297(R) (LAMS-2681)

IRON–TITANIUM ALLOYS
magnetic properties of Laves-phase structures, 16: 16833

IRON–URANIUM ALLOYS
eutectic temperature, 16: 17297(R) (LAMS-2681)

IRON–ZINC ALLOYS
phase studies of nitrogen containing, 16: 16768

IRON–ZIRCONIUM ALLOYS
magnetic properties of Laves-phase structures, 16: 16833

IRRADIATION FACILITIES
design of teletherapy head with shielded source, 16: 16163(P)

IRRADIATION TECHNIQUES
in-pile, 16: 16785

ISOTOPE SEPARATION METHODS
centrifugal, bibliography on gas, 16: 16627 (NUCLEAR-52)
electrodiffusion in ion exchange column, 16: 16629
survey, 16: 16036

ISOTOPES
production by gamma irradiation in magnetic field, 16: 16447(P)

J

JOURNAL BEARINGS
whirl behavior of air-lubricated, 16: 16475 (NP-11494)

K

KANSAS
base rock age, 16: 16577 (TID-14861(Vols.I&II))

KAOLINS
reactions with barium, lead, and strontium sulfates, solid state formation of feldspars in, 16: 16578

KIDNEYS
function, effects of local abdominal irradiation and nephrotoxic serum, 16: 16195

KRYPTON
electron transfer collisions near adiabatic conditions with carbon atoms and ions, hydrogen atoms and ions, lithium ions, and oxygen atoms, 16: 16868
neutron reactions at 6.4 to 12 Mev, disintegration in, 16: 17099
purification from traces of xenon, 16: 16455 (CEA-2111)

KRYPTON ISOTOPES Kr-85
diffusion from irradiated uranium dioxide, 16: 16756
use for leak detection in hermetically sealed components, 16: 16071

KRYPTON–OXYGEN SYSTEMS
electron transfer collisions near adiabatic conditions, 16: 16868

L

LABORATORY EQUIPMENT
design of centrifuge for use in glove box, 16: 16486(P)

LANTHANUM
separation by solvent extraction using hydrogen 2-ethylhexyl phenacyl phosphonate, steric effects in, 16: 16366
separation from cadmium by coprecipitation with cadmium–cerium alloy, 16: 16464

LANTHANUM SULFIDES
thermal properties of semiconducting at 800°K, 16: 16799(R) (AD-265462)

LARVAE
radiation effects on Mexican fruit-fly, in grapefruit, 16: 16123
radiation effects on fertility and survival of grain weevil, continuous and fractionated dose, 16: 16125

LEAD
gamma and neutron attenuation, calculation methods for, 16: 17161
meson (K_2^0) interactions at 100 Mev, hyperon production, 16: 17051
separation from bismuth, cadmium, copper, silver, and zinc by cation exchange, 16: 16463

LEAD (LIQUID)
distribution of antimony between liquid or solid iron and, 16: 16053

LEAD ISOTOPES
determination in pitchblendes, mass spectrometric, 16: 16825
geochemistry, survey, 16: 16577 (TID-14861(Vols.I&II))

LEAD ISOTOPES Pb-205
energy level decay, 16: 17096

LEAD ISOTOPES Pb-207
energy levels from thallium-207 beta decay, 16: 17080

LEAD ISOTOPES Pb-212
conversion lines in bismuth-210 beta spectrum measurements, 16: 17105

LEAD NITRATES
radiolysis, effects of intensity on, 16: 16425

LEAD SULFATES
reactions with clays, solid state formation of feldspars in, 16: 16578

LEAD TITANATE–LEAD ZIRCONATE SYSTEMS
phase transitions in ferroelectric rhombohedral, 16: 16743

LEAD–ZINC ALLOYS (LIQUID)
solvent properties for cerium and palladium, 16: 16464

LEAK DETECTORS
radioisotope method for hermetically sealed components, 16: 16071

LEPTONS
properties and theory, 16: 16995 (NP-11592(Vol.II)(p.15-19))

LEUCINE

  analysis for tritium by liquid scintillation, 16: 16091
  determination in protein hydrolyzates using carbon-14 or tritium labeled 1-fluoro-2,4-dinitrobenzene, 16: 16089

LID TANK FACILITY
  neutron dosimetry by reactions in oil and water, 16: 17064 (CNLM-3244)

LIFE SPANS
  biological factors, 16: 16228

LIGHT SOURCES
  construction and characteristics of packaged self-luminous promethium-147-activated, 16: 16621
  performance of pulsed, with gallium phosphide diode, 16: 16551

LIGHTNING
  mechanism, analysis, 16: 17182(T) (FTD-TT-61-149)

LINEAR ACCELERATORS
  misalignments and random errors in proton, 16: 17156 (AERE-T/M-126)

LIQUID FLOW
  distribution between two vertical parallel plates, pitot tube design for, 16: 16510

LIQUID METAL COOLED REACTORS
  corrosion problems survey, 16: 16036
  design of sodium-heavy water, with barrier system, 16: 17266(P)

LIQUIDS
  diffusion coefficients of gases in, 16: 16351
  x-ray diffraction analysis, beryllium sample cell design for, 16: 16560

LITHIUM
  emission spectra at high temperatures, pressure effects on, 16: 16819
  magnetic spin susceptibility and thermal conductivity, 16: 16713 (AROD-431:44)
  reactions with helium, energy curves for, 16: 16353
  separation from cadmium by coprecipitation with cadmium–cerium alloy, 16: 16464

LITHIUM (LIQUID)
  solvent properties for iron and nickel, 16: 16689 (TID-7626(Pt.I)(p.143-5))

LITHIUM CHLORIDE–POTASSIUM CHLORIDE SYSTEMS
  analysis for cadmium, nickel, and zinc, controlled potential coulometric, 16: 16310

LITHIUM CHLORIDES
  activity coefficients in methanol–water mixture at 25°C, rule for calculation, 16: 16375
  reactions with plutonium(III) chlorides, 16: 16367

LITHIUM FLUORIDE CRYSTALS
  thermal conductivity, effects of imperfections, 16: 16058

LITHIUM HYDRIDES
  excited state potential energy curves, 16: 16872
  neutron attenuation, 16: 17237 (NASA-TN-D-1184)
  positron annihilation in, spectra from, 16: 17012
  potential energy curves for, 16: 16821

LITHIUM ION BEAMS
  plasma potential measurements using, 16: 17187

LITHIUM IONS
  electron transfer collisions near adiabatic conditions with argon, hydrogen, krypton, and xenon, 16: 16868

LITHIUM ISOTOPES Li-6
  model for, three-body, 16: 17079
  neutron scattering at 0.1 to 2.4 Mev, polarization asymmetries, 16: 17091

LITHIUM ISOTOPES Li-7
  neutron scattering at 0.1 to 2.4 Mev, polarization asymmetries, 16: 17091
  photon absorption giant resonance, dipole, 16: 17109
  proton reactions (p,α), alpha angular distributions, 16: 17141
  proton reactions (p,n) at 0.1 to 2.4 Mev, polarization asymmetries from, 16: 17091

LITHIUM ISOTOPES Li-8
  production in proton-nucleus reactions at 24.8 Bev/c, angular and energy distributions, 16: 16940 (NP-11592(Vol.I)(p.117-20))

LITHIUM ISOTOPES Li-9
  production in proton-nucleus reactions at 24.8 Bev/c, angular and energy distributions, 16: 16940 (NP-11592(Vol.I)(p.117-20))

LITHIUM OXIDES
  diffusion of calcium, potassium, and sodium ions in, in melts with silicon oxide–sodium oxide systems, 16: 16048

LITTLE BELT MOUNTAINS (MONT.)
  metamorphic history of base rock, 16: 16577 (TID-14861(Vols.I&II))

LIVER
  Dieldrin content and effects in mice, injected, 16: 16114
  radiation effects on cytoplasm, whole-body exposure, 16: 16235
  radiosensitivity of enzymes in nuclei, 16: 16219

LOS ALAMOS MOLTEN PLUTONIUM REACTOR EXPERIMENTS
  operation and development, 16: 17297(R) (LAMS-2681)

LUBRICANTS
  electrokinetic and sedimentation properties of additive containing, tracer study, 16: 16064
  preparation of radiation-resistant, 16: 16797(P)
  preparation of radiation-resistant oil, 16: 16798(P)

LUBRICATION
  magnetohydrodynamic theory, 16: 16855
  processes in small-scale uses, study by tracer methods, 16: 16063
  study in large diesel engines by tracer methods, 16: 16062

LUMINESCENT DETECTORS
  performance evaluation in Upshot-Knothole operation, 16: 16530 (WT-755)

LUNGS
  radioinduced cancers in, 16: 16177 (NYO-10056)

LUTETIUM
  Auger electrons, energy and intensity, 16: 16823
  solubility in cadmium(liquid), 16: 16464

LUTETIUM ISOTOPES Lu-172
  energy levels and isomers, 16: 17111

LUTETIUM ISOTOPES Lu-173
  energy levels, 16: 17110

LUTETIUM ISOTOPES Lu-175
  hyperfine structure, 16: 17128

LUTETIUM ISOTOPES Lu-176
  hyperfine structure and nuclear spin, 16: 17128
  neutron capture, rate measurements, 16: 17233 (CRRP-985-D)

LUTETIUM ISOTOPES Lu-177
  decay schemes, 16: 17093

LYSINES
  determination in protein hydrolyzates using carbon-14 or tritium labeled 1-fluoro-2,4-dinitrobenzene, 16: 16089

M

MACHINE TOOLS
  spindle expansion effects on lathe-type, 16: 16473 (HW-71980)
  wear of shearing dies and punches, radiological measurements, 16: 16067

MAGNESIUM
  development and properties for fuel element cladding, review, 16: 16661
  neutron scattering at 0.1 to 2.4 Mev, polarization asymmetries, 16: 17091
  oxidation and squeeze energy principle, 16: 16696
  oxidation kinetics in water-saturated oxygen at 350 to 600°C, 16: 16348
  production by vaporization and condensation, retort cover for, 16: 16673(P)
  structural properties and uses in reactors, survey, 16: 16036

MAGNESIUM ALLOYS
  fatigue under strain-controlled low-cycle conditions, 16: 16767
  oxidation and squeeze energy principle of Magnox A 12, 16: 16696
  structural properties and uses in reactors, survey, 16: 16036

MAGNESIUM IONS
  thermodynamic equilibrium in chromosphere, departures from, 16: 16898

MAGNESIUM ISOTOPES Mg-24
  excited state spectrum, first, 16: 17108
  photon absorption giant resonance, dipole, 16: 17109

MAGNESIUM ISOTOPES Mg-25
  energy levels from silicon-28 (n,α) reactions at 14.6 Mev, 16: 17076
  photon absorption giant resonance, dipole, 16: 17109
  proton capture (p,γ) at 0.95 to 1.80 Mev, gamma spectra from, 16: 17103

MAGNESIUM ISOTOPES Mg-26
  triton reactions (t,α) at 5.75 and 5.96 Mev, energy levels from, 16: 17092

MAGNESIUM–MANGANESE ALLOYS
cavitation and creep properties at 20 to 500°C, 16: 16762
MAGNESIUM–MANGANESE–ZIRCONIUM ALLOYS
cavitation and creep properties at 20 to 500°C, 16: 16762
MAGNESIUM OXIDE CRYSTALS
physical properties at 1700 to 2000°K, effects of heat treatments, 16: 16726(R) (NP-11311)
MAGNESIUM–SILVER ALLOYS
solvent properties for chromium–uranium alloy fuels, 16: 16464
MAGNESIUM SULFATES
analysis for molybdenum and tin by solvent extraction with 8-quinolinol, spectrophotometric, 16: 16314
MAGNETIC FIELDS
charged particle motion in inhomogeneous, 16: 17197
Cherenkov emission from charged particles in circular orbit in external, 16: 17033
detection and measurement in solar atmosphere, 16: 16897
errors at low flux in synchrotrons, 16: 17164
measurement in spiral-ridge cyclotrons, 16: 17165
plasma diffusion across, 16: 17175 (AFCRL-1028)
plasma diffusion in uniform one dimensional, 16: 17198
plasma stability in homogeneous, 16: 17193
production of high, review, 16: 16828
sector boundaries in homogeneous exact focusing, 16: 17170
use for curving high-energy particles in nuclear emulsions, 16: 16966 (NP-11592(Vol.I)(p.301-5))
MAGNETIC MATERIALS
properties, review, 16: 16827
MAGNETIC MIRROR MACHINES
switch design for high-current circuit in, 16: 17219(P)
MAGNETIC PROPERTIES
review, 16: 16827
similarities analysis, 16: 17174 (AD-266636)
MAGNETIC RESONANCE
in measurements of radiation-produced radicals, 16: 16434
MAGNETIC SUSCEPTIBILITY
measurement device, design, 16: 16513 (AE-64)
MAGNETISM
conference at Phoenix, Ariz., November 1961, 16: 16827
spin screw structure, anisotropy energy and magnetic field effects on, 16: 16829
MAGNETITES
age of Cornwall, Pa., 16: 16577 (TID-14861(Vols.I&II))
MAGNETOHYDRODYNAMIC CELLS
bibliography on direct energy conversion by, 16: 16808 (NP-11472)
materials development, 16: 17314(R) (AD-266439)
power levels, 16: 17314(R) (AD-266439)
tensor conductivity effects on and currents in crossed field, having skewed electrodes, 16: 17188
MAGNETOHYDRODYNAMICS
boundary layer flow of incompressible conducting fluid past magnetized flat plate, 16: 16512
equations, analysis of intrinsic, 16: 17174 (AD-266636)
flow, exact solutions to class of linearized problems in, 16: 16806 (BSD-TDR-62-42)
flow of incompressible conducting fluid in axisymmetric tubes, 16: 16854
flow of incompressible electrically conducting gases, effects of magnetic field of current loop, 16: 16812 (SCR-439)
lubrication theory in, 16: 16855
magnetic-field effects on gravity propagation in electrically-conducting fluids, 16: 16899
oscillations of self-gravitating fluids, 16: 16900
plasma containment, applications of integral theorems, 16: 17330
theory, differential solutions for pressure-compensated fields, 16: 16638
MAGNETOMETERS
design of free-precession nuclear, 16: 16519 (CEA-1931)
MAGNETS
design and construction for beam transport systems, 16: 17160
development for generation of 100,000-gauss fields, 16: 16828
development of superconducting high-field, 16: 16830
field control in Princeton-Pennsylvania 3-Bev Proton Synchrotron, 16: 17157 (PPAD-442D)
MALONONITRILE
protective effects against radiation injuries and nitrogen mustard in *E. coli*, 16: 16297
MAN
analysis for internally-deposited radioactivity, whole-body counting, 16: 16133
analysis for internally-deposited gamma radiation, whole-body counting, 16: 16143
analysis for internally deposited gamma radiation, 16: 16144
analysis for internally deposited radioactivity, whole-body counting, 16: 16145
analysis for internally deposited radium and thorium, whole-body counting, 16: 16146
analysis for internally or externally deposited radioactivity, whole-body counting, 16: 16150
analysis for internally deposited tracer elements, whole-body counting, 16: 16155
analysis for internally-deposited radioisotopes, 16: 16158
analysis for natural radioactivity, whole-body counting, 16: 16134
analysis for plutonium-239, partial-body counting, 16: 16148
analysis for potassium, lean body mass, and total fat content by whole-body counting methods employing potassium-40 and tritiated water, 16: 16151
analysis for radioactivity, whole-body counting, 16: 16136
analysis for radioactivity, whole-body counting, 16: 16137
analysis for radioactivity, whole-body counting, 16: 16139
analysis for radioactivity, whole-body counting, 16: 16140
analysis for radioactivity, whole-body counting, 16: 16141
analysis for radioactivity, whole-body counting, 16: 16142
analysis for radium, whole-body counting, 16: 16147
analysis for radium, whole-body counting, 16: 16171
analysis for sodium-22, whole-body counting, 16: 16156
anatomical characteristics affecting geometries in whole-body counting, 16: 16138
bone marrow content measurements, tracer method, 16: 16107
excretion of cesium-137, effects of potassium intake, 16: 16152
genetic effects of radiation, 16: 16225
pulmonary deposition and clearance of particles, tracer study using whole-body counting, 16: 16149
radiation effects on population from radioactive areas on island, 16: 16173
MANGANESE
determination in uranium compounds, spectrographic, 16: 16304 (CNEN-96)
radiation effects on availability in soils, 16: 16176 (NP-11578)
MANGANESE ISOTOPES Mn-51
beta and gamma spectra and energy levels, 16: 17148
MANGANESE ISOTOPES Mn-55
energy levels excited by 6.6-Mev protons, 16: 17146
neutron capture, rate measurements, 16: 17233 (CRRP-985-D)
proton inelastic scattering at 6.6 Mev, 16: 17146
MANGANESE ISOTOPES Mn-56
beta decay, beta-gamma correlation, 16: 17144
retention of recoil, in neutron irradiated potassium permanganate at low temperatures, 16: 16423
MANGANESE–NICKEL–URANIUM ALLOYS
phase studies, eutectic temperature and composition, 16: 17297(R) (LAMS-2681)
MANGANESE OXIDES
sorptive properties in aqueous solutions, 16: 16389
sorptive properties for protactinium, 16: 16396
MANGANESE–PLATINUM ALLOYS
atomic magnetic moment of platinum in, 16: 16838
MANGANESE–PLUTONIUM–URANIUM ALLOYS
corrosive effects on ceramic materials at 900 to 1000°C, 16: 17297(R) (LAMS-2681)
MANGANESE–RARE EARTH ALLOYS
phase studies at 75 to 90 at.% manganese, intermediate, 16: 16744
MANGANESE–RUTHENIUM–URANIUM ALLOYS
phase studies, eutectic temperature and composition, 16: 17297(R) (LAMS-2681)
MANGANESE–SILICON–URANIUM SYSTEMS

phase studies, eutectic temperature and composition, 16: 17297(R) (LAMS-2681)
MANGANESE STEEL
radiation effects on strain-aged pressure vessel, 16: 16773 (AE-65)
MANGANESE–URANIUM ALLOYS
corrosive effects on ceramic materials at 900 to 1000°C, 16: 17297(R) (LAMS-2681)
phase studies, 16: 17297(R) (LAMS-2681)
MANGANESE–YTTRIUM ALLOYS
phase studies at 75 to 90 at.% manganese, intermediate, 16: 16744
MANGANESE–ZINC ALLOYS
phase studies of nitrogen containing, 16: 16768
MARITIME GAS COOLED REACTOR
fuel materials, radiation-effects studies of candidate, 16: 17229(R) (BMI-1565(Del.))
MASS SPECTROGRAPHY
thermal ionization, internal standard technique for precise isotopic abundance measurements in, 16: 16317
MASS SPECTROMETERS
ion sources, initial velocity discrimination effects in crossed-field, 16: 16846
MATERIALS TESTING
equipment and methods for mechanical evaluation of refractory materials at 4000°F, 16: 16572 (ASD-TR-61-74)
nondestructive techniques assessing radiation damage to pressure vessels, 16: 16791
nondestructive, uses of particle accelerators in, 16: 17162
MATERIALS TESTING REACTOR
fuel element design and performance, review, 16: 16669
MATHEMATICS
book: *Group Theory*, 16: 16639
determination of the minima-of-functions coordinates by linearization, 16: 16634 (JINR-D-810)
theory of strong interactions, 16: 17066 (IA-698)
MEDICINE
Second International Congress of Neurological Surgery, Washington, D. C., Oct. 1961, 16: 16241
MEMBRANE FILTERS
preparation with graduated pore size from synthetic resins, 16: 16490(P)
MEMBRANES
radiation effects on irritation processes in, within the body, 16: 16287
MERCURY
corrosive effects on titanium alloys at 700°F, 16: 16683 (TID-7626 (Pt.I)(p.107-8))
corrosive effects, conference, 16: 16676 (TID-7626(Pt.I))
corrosive effects on carbon steel at 600 to 1400°F, 16: 16677 (TID-7626 (Pt.I)(p.23-34))
spectra, hyperfine structure of forbidden 2815 Å mercury II line and isotopic displacement constant, 16: 16878
thermophysical properties, 16: 16741
MERCURY ELECTRODES
analytical applications, review, 16: 16318
MERCURY ISOTOPES Hg-196
electron (K) conversion coefficient at 426 kev, 16: 17100
MERCURY ISOTOPES Hg-198
energy levels, 16: 17081
MERCURY ISOTOPES Hg-200
energy levels, 16: 17113
MERCURY ISOTOPES Hg-203
beta decay, internal conversion coefficient at 279 kev, 16: 17075
uptake in brain tumors, 16: 16231
MESIC ATOMS
energy level excitation in heavy, collective, 16: 17151
processes in gaseous hydrogen, experimental study, 16: 16884
MESONS
correspondence theorem for bare, 16: 17041
gauge transformations for vector fields, 16: 17018
interactions with nucleons, solution of low equation, 16: 17224
resonances and threshold mass numerologies in, 16: 17028
spectra of peripheral, in fast nucleons, 16: 17016
MESONS (K)
existence and spin of (K^*), 16: 17048
interactions with mesons (π), s-wave amplitude for, 16: 17024
interactions with mesons (π), K-π and π-π resonance effects on p-wave, 16: 17025
interactions with mesons (π) at low energies, strangeness violation in, 16: 17048
properties of scalar, spin-zero (K^*), 16: 17049
MESONS (K^-)
absorption by nuclei, hyperon effects, 16: 16980 (NP-11592(Vol.I)(p.389-94))
capture by emulsion nuclei, use as evidence of Y isobar, 16: 16981 (NP-11592(Vol.I)(p.397-406))
interactions with protons, transition matrix for, 16: 17040
interactions with protons at 1.1 to 1.4 Bev/c, 16: 17042
interactions with mesons (K^+), meson (ω) and (ρ) production in, 16: 17043
interactions with nucleons, cross-section maxima in, 16: 17043
interactions with mesons (K^+), transitions to mesons (ω) and (ρ) in, 16: 17044
interactions with mesons (K^+), dispersion relations in, 16: 17047
interactions with mesons (π), (K^*) pole contribution to, 16: 17049
interactions with mesons in nuclear emulsions at 800 Mev, 16: 16975 (NP-11592(Vol.I)(p.359-61))
interactions with emulsion nuclei at 800 Mev, hyperfragment production, 16: 16976 (NP-11592(Vol.I)(p.363-9))
MESONS (K^0)
decay modes, 16: 16956 (NP-11592(Vol.I)(p.241-5))
decay of K_1^0, branching ratios and half lives, 16: 16954 (NP-11592 (Vol.I)(p.227-34))
decay scheme, use in testing $\Delta Q = \Delta S$ selection rule, 16: 16953 (NP-11592(Vol.I)(p.209-15))
interactions with lead nuclei at 100 Mev, hyperon production, 16: 17051
interactions with protons at 200 to 600 Mev, 16: 16955 (NP-11592 (Vol.I)(p.235-9))
production of pairs in propane by mesons (π^-) at 6.1, 11.6 and 18.1 Bev, 16: 16938 (NP-11592(Vol.I)(p.101-10))
MESONS (K^+)
interactions with mesons (K^-), meson (ω) and (ρ) production in, 16: 17043
interactions with mesons (K^-), transitions to mesons (ω) and (ρ) in, 16: 17044
interactions with protons, amplitude studies by dispersion relations, 16: 17047
interactions with mesons (K^-), dispersion relations in, 16: 17047
interactions with nucleons, differential and total cross sections at 0.8 to 2.9 Bev, 16: 16957 (NP-11592(Vol.I)(p.247))
MESONS (μ)
behavior and properties, 16: 16994 (NP-11592(Vol.II)(p.3-13))
capture by liquid helium, 16: 16943 (NP-11592(Vol.I)(p.141))
decay ($\mu \to e + \gamma$), search for, 16: 17056
decay schemes, 16: 16950 (NP-11592(Vol.I)(p.191-5))
scattering by electrons at 8.12 Bev, 16: 16945 (NP-11592(Vol.I)(p.147-50))
MESONS (μ^-)
decay rates of iron nuclei K-orbit bound, 16: 16944 (NP-11592(Vol.I)(p.143-5))
MESONS (ω)
production in meson (K^-)-meson (K^+) interactions, 16: 17043
role in nucleon core phenomena, 16: 17044
MESONS (ω^0)
photoproduction from hydrogen, attempts at detection, 16: 17065 (CTSL-32)
production in meson (π) interactions (s- and p-wave), 16: 17037
MESONS (π)
interactions at 1.89 Bev for hyperon production, 16: 16977 (NP-11592 (Vol.I)(p.371-4))
interactions, coincidence measurements in, 16: 17036
interactions, dispersion relations in, 16: 17047
interactions, range formulas for s- and p-wave, 16: 17037
interactions with nucleons, phase-space integral for 25 Bev collision, 16: 17020
interactions with mesons (K), s-wave amplitude for, 16: 17024
interactions with mesons (π), p-wave resonance effects in K-π scattering,

16: 17024
interactions with mesons (K), K-π and π-π resonance effects on p-wave, 16: 17025
interactions with hyperons, resonance state, 16: 17032
interactions with nucleons, coincidence measurements from, 16: 17036
interactions with mesons (K) at low energies, strangeness violation in, 16: 17048
interactions with mesons (K), (K^*) pole contribution to, 16: 17049
interactions with mesons (π), phenomenological description, 16: 17052
interactions with nucleons, phenomenological description, 16: 17052
interactions with mesons (π) at high energies, amplitude behavior of elastic, 16: 17053
interactions with mesons (π) at low energies, resonance solutions of equations, 16: 17054
interactions with nucleons at high energies, scattering amplitude analysis, 16: 17069 (JINR-D-922)
interactions with mesons (π), phase shifts, 16: 16969 (NP-11592(Vol.I)(p.331-5))
interactions with nucleons, phase shifts at 0 to 350 Mev, 16: 16988 (NP-11592(Vol.I)(p.461))
interactions with nucleons at 400 to 1500 Mev, mechanisms, 16: 16989 (NP-11592(Vol.I)(p.467-83))
interactions with nucleons at 20 Bev, photon emission in, 16: 17014
low-energy physics, theory, 16: 16999 (NP-11592(Vol.II)(p.87-102))
parameters of low-energy, best fit data, 16: 16987 (NP-11592(Vol.I)(p.459))
production by proton interaction at 24 Bev, 16: 16984 (NP-11592(Vol.I)(p.433-47))
production of charged in proton annihilation, 16: 16961 (NP-11592(Vol.I)(p.269-75))
resonance states, 16: 16998 (NP-11592(Vol.II)(p.57-85))
scattering by mesons (π), amplitudes, 16: 16971 (NP-11592(Vol.I)(p.343-6))
scattering by nucleons, analysis of low-energy s-wave, 16: 16973 (NP-11592(Vol.I)(p.351-4))
scattering by nucleons, dispersion relations for forward, 16: 16991 (NP-11592(Vol.I)(p.485-6))
scattering interactions with mesons (π), partial waves effects, 16: 17067 (JINR-D-857)
scattering lengths, $\bar{K}N$ and KN energy dependent S-wave, 16: 16974 (NP-11592(Vol.I)(p.355-8))
structure, electromagnetic aspects, 16: 16997 (NP-11592(Vol.II)(p.33-55))

MESONS (π^-)
absorption and elastic scattering on emulsion nuclei at 5.7 Bev, 16: 16964 (NP-11592(Vol.I)(p.291-4))
interactions at 16 and 24 Bev, cross section for strange particle production, 16: 16937 (NP-11592(Vol.I)(p.93-100))
interactions with protons at 300 to 1600 Mev, total cross section for neutral processes, 16: 16932 (NP-11592(Vol.I)(p.45-55))
interactions with mesons (π^-) at 16 Bev, electron-pair production, 16: 16935 (NP-11592(Vol.I)(p.79-83))
interactions with protons at 6.1, 11.6, and 18.1 Bev, production of K^0 and V^0 pairs, 16: 16938 (NP-11592(Vol.I)(p.101-10))
interactions with protons near 900 Mev, strange particle distributions from, 16: 16952 (NP-11592(Vol.I)(p.203-7))
interactions with protons at 1.89 Bev, 16: 16958 (NP-11592(Vol.I)(p.249-56))
interactions with protons at 1.6 Bev/c, resonance effects, 16: 16959 (NP-11592(Vol.I)(p.257-64))
interactions with protons at 1.25 Bev, π–π resonance values, 16: 16960 (NP-11592(Vol.I)(p.265-7))
interactions with protons at 1.6 Bev/c, strange particle distributions from, 16: 16978 (NP-11592(Vol.I)(p.375-83))
interactions with protons at 1 to 5 Bev/c, hyperon production, 16: 16979 (NP-11592(Vol.I)(p.385-8))
interactions with protons at 16 Bev, 16: 16982 (NP-11592(Vol.I)(p.407-17))
interactions with protons at 6 and 18 Bev, 16: 16985 (NP-11592(Vol.I)(p.449-52))
interactions with protons at 6.1 and 18.1 Bev, jet distribution, 16: 16986 (NP-11592(Vol.I)(p.453-7))
production by proton-proton reactions at 2.1 and 2.9 Bev, 16: 16933 (NP-11592(Vol.I)(p.57-67))
proton scattering at 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))

MESONS (π^0)
decay rate from Compton scattering of protons, 16: 17026
lifetime calculation using relativistic time dilation, 16: 17006 (UCRL-10118)
photoproduction in hydrogen at 600 to 800 Mev, 16: 16926 (NP-11592(Vol.I)(p.9-15))

MESONS (π^+)
decay ($\pi^+ \rightarrow \pi^0 + e^+ + \gamma$), experimental measurement of the probability of, 16: 17057
interactions with protons at 310 Mev, production cross section for mesons (π), 16: 16929 (NP-11592(Vol.I)(p.25-6))
interactions with deuterons, three-pion resonances in, 16: 16962 (NP-11592(Vol.I)(p.277-82))
photoproduction in hydrogen at 600 to 800 Mev and angles of 0 to 20° c.m., 16: 16928 (NP-11592(Vol.I)(p.21-4))
production by proton-proton reactions at 2.1 and 2.9 Bev, 16: 16933 (NP-11592(Vol.I)(p.57-67))
proton reactions (P,π) at 310 Mev, 16: 16930 (NP-11592(Vol.I)(p.27-35))
proton scattering at 820 and 900 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))

MESONS (ρ)
production in meson (π) interactions (s- and p-wave), 16: 17037
production in meson (K^-)-meson (K^+) interactions, 16: 17043
role in nucleon core phenomena, 16: 17044

METABOLISM
Dipterex in normal and resistant flies, 16: 16116
insect, technical problems of radioisotope measurement in, 16: 16120
tracer studies, 16: 16162
tracer studies using iron-59, calcium-47, and carbon-11, 16: 16160
tritium labeled thymidine incorporated into desoxyribonucleic acid, single phototube liquid scintillation measurements, 16: 16098

METAL COUPLES
thermal resistance of contacts, methods of surface analysis for prediction, 16: 16476(R) (NYO-9457)

METAL SPRAYING
combustion powder and rod and plasma flames in, 16: 16703

METALLIC FILMS
production from separated isotopes by cathodic sputtering, chamber design for, 16: 16433

METALS
abundances in high-velocity A stars, ratio to hydrogen, 16: 16896
bibliography on refractory, 16: 16727 (NP-11553)
brazing of reactive, torch for, 16: 16492(P)
deformation during fabrication into tubes, study using radioactive inserts, 16: 16055
diffusion rates near free surfaces, 16: 16045
magnetic and thermal properties, effects of electron interactions, 16: 16713 (AROD-431:44)
radiation damage studies, equipment and techniques used in, 16: 16795
radiation effects in engineering uses, 16: 16625
sorptive properties for protactinium, 16: 16388

METALS (LIQUID)
condensation at high temperatures, 16: 16685 (TID-7626(Pt.I)(p.111-14))
viscosity measurements, torsional oscillation method for, 16: 16343(T) (NASA-TT-F-88)

METEORITES
ages by rhenium/osmium determination, 16: 16040
analysis for indium by activation, cellulose acetate–dithizone columns for, 16: 16319
analysis of Tunguska event, 16: 16032(T) (JPRS-13480)
argon-37 and tritium content in chondritic, 16: 16080
radiation ages by cosmic-ray activation analysis, 16: 16039
use to measure solar-system cosmic ray flux, by induced activity, 16: 16038

METEOROLOGY
measurements during IGY, survey, 16: 16817
particle transport in atmosphere, tracer study, 16: 16584

METHACRYLIC ACID, METHYL ESTER POLYMERS
neutron reactions in, cross sections and spatial distributions, 16: 17059

- **METHANE**
  - determination in geothermal bores, fumaroles, and pools in New Zealand, mass spectrometric, 16: 16581
  - electronic energy, 16: 16357
  - radiolysis in gaseous phase, effects of intensity, pressure, and temperature on, 16: 16419
  - tritium content of atmospheric, over Australia, Singapore, and United Kingdom, 1957 to 1959, 16: 16079
  - yields in gamma radiolysis of methylcyclohexane, 16: 16417
  - yields in gamma radiolysis of methylcyclohexane, effects of benzene on, 16: 16418
- **METHANE, TRICHLOROFLUORO-**
  - boiling on horizontal plate, film, 16: 16508
- **METHANOL**
  - Cannizzaro reactions in, mechanism, 16: 16087
  - radiolysis, isotope effects of deuterium and tritium in, 16: 16086
- **METHANOL–WATER SYSTEMS**
  - activity coefficients of salts in, rule for calculation, 16: 16375
- **METHIONINE**
  - protective effects against radiation injuries and nitrogen mustard in *E. coli*, 16: 16297
- **METHYLENE BLUE**
  - protective effects against radiation injuries and nitrogen mustard in *E. coli*, 16: 16297
- **MICE**
  - radiation-conditioned behavior, effects of habituation to laboratory and radiation procedures, 16: 16266
  - radiation effects on aging and behavior, 16: 16269
  - radiation effects on brain, histochemical studies, 16: 16276
  - radiation effects on nervous system, 16: 16283
- **MICROLITES**
  - analysis for niobium and tantalum by ion exchange, 16: 16312
- **MICROÖRGANISMS**
  - radiation effects on, application to crop protection, 16: 16110
- **MICROWAVES**
  - interactions with plasma, 16: 17178 (ML-793)
- **MILK**
  - analysis for iodine-131 content of bulk samples, radiometric, 16: 16594 (AEEW-R-138)
  - protective effects of dietary, against radiation injuries in dog, 16: 16294
- **MINERAL DEPOSITS**
  - prospecting, exploration, and working methods, 16: 16043
- **MINERALS**
  - analysis for argon and helium for age estimations, 16: 16577 (TID-14861(Vols.I&II))
- **MINING**
  - nuclear-physical methods in, review, 16: 16043
  - radiation hazards in, of uranium, 16: 16592 (AEET/HP/SM-4)
- **MOLECULAR STRUCTURE**
  - electrostatic energy matrices of f^7 configuration, 16: 16356
- **MOLECULES**
  - electronic energy and isotope effects in, 16: 16357
  - rotational states of polar, in rare gas crystals, 16: 16330 (AD-264708)
- **MOLTEN SALT REACTOR EXPERIMENT**
  - kinetics analysis, computer program for, 16: 17239 (ORNL-TM-203)
- **MOLYBDENUM**
  - alloying effects on creep properties of niobium–zirconium alloy, 16: 16772(P)
  - characteristics as radiation target, incorporated into nuclear emulsion, 16: 16967 (NP-11592(Vol.I)(p.307-25))
  - corrosion by cesium at 1600 to 2500°F, 16: 16684 (TID-7626(Pt.I)(p.109-10))
  - corrosion by liquid cerium at 800 to 1200°C, 16: 16693
  - determination in reactor materials by solvent extraction with 8-quinolinol, spectrophotometric, 16: 16314
  - secondary ion emission during ion bombardment, 16: 16880
  - secondary ion emission during bombardment with cesium and rubidium ions, 16: 16881
- **MOLYBDENUM ALLOYS**
  - corrosion by high-temperature potassium, 16: 16680 (TID-7626(Pt.I)(p.69-86))
- **MOLYBDENUM COMPLEXES**
  - with niobium, formation and reduction, 16: 16315
- **MOLYBDENUM FLUORIDES**
  - physical properties, 16: 16464
- **MOLYBDENUM ISOTOPES Mo-100**
  - neutron capture, rate measurements, 16: 17233 (CRRP-985-D)
- **MOLYBDENUM OXYFLUORIDES**
  - physical properties, 16: 16464
- **MOLYBDENUM–RHENIUM ALLOYS**
  - crystal structure, 16: 16705 (62-GC-206)
  - superconductivity, 16: 16830
- **MOLYBDENUM–TITANIUM ALLOYS**
  - corrosion by potassium at 1000 to 1800°F, 16: 16679 (TID-7626(Pt.I)(p.63-8))
- **MOLYBDENUM–TITANIUM–ZIRCONIUM ALLOYS**
  - preparation by arc-melting, 16: 16724(R) (NMI-9238)
- **MOLYBDENUM–ZIRCONIUM ALLOYS**
  - corrosion by potassium at 1000 to 1800°F, 16: 16679 (TID-7626(Pt.I)(p.63-8))
- **MONKEYS**
  - radiation-conditioned behavior, effects of habituation to laboratory and radiation procedures, 16: 16266
  - radiation effects on behavioral changes, 16: 16267
  - radiation effects on central nervous system, 16: 16277
- **MONTE CARLO METHOD**
  - comparison with phase-space integral for mesons (π)-nucleon collisions, 16: 17020
- **MOON**
  - radiation doses at surface, 16: 17329
  - surface composition analysis, gamma-neutron spectrometer for, 16: 16532
- **MOUTH**
  - radiation effects on mucous membrane, 16: 16213
- **MUCOSA**
  - radiation effects on oral, 16: 16213
- **MUSCLES**
  - radiation effects on presynaptic failure of neuromuscular transmissions, 16: 16258
  - radiation effects on electric properties of frog, 16: 16181(T) (JPRS-13154(p.8-15))
- **MUTATIONS**
  - extrachromosomal, induced in yeast by ultraviolet radiation, 16: 16222
  - in Drosophila, effects of asynapsis, 16: 16203
  - radiation effects on, in *Neurospora crassa*, 16: 16191
  - radioinduced in Drosophila, 16: 16201
  - radioinduced in Drosophila, 16: 16202
  - radioinduced in Drosophila, 16: 16204
  - radioinduced in male insects, role in control of populations, 16: 16129

N

- **NAGASAKI**
  - genetic effects of radiation on population, 16: 16225
- **NAPHTHACENE**
  - exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344
- **NAPHTHALENE**
  - exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344
- **NAPHTHALENE CRYSTALS**
  - excitation transfer in normal-deuterium labeled, 16: 16379
- **NAVAL VESSELS**
  - contamination of surfaces, fall-out simulation, 16: 16611 (USNRDL-TR-549)
- **NEBULAE**
  - origin of planetary, 16: 16914
  - spectra of helium in, 16: 16895
- **NECK**
  - radiotherapy of esophagus, effects on cardiovascular system, 16: 16208
- **NEODYMIUM**
  - nuclear magnetic moments, spin-orbit coupling, and hyperfine fields, 16: 16831
  - specific heats at 300 to 1100°K, 16: 16746

NEODYMIUM ISOTOPES Nd-140
isomers, existence of new short-period metastable, 16: 17147
NEODYMIUM ISOTOPES Nd-143
nuclear magnetic moments, 16: 16831
spin, 16: 17128
NEODYMIUM ISOTOPES Nd-145
spin, 16: 17128
NEODYMIUM RUTHENATES
magnetic susceptibility at 2 to 1300°K, 16: 16837
NEODYMIUM SULFATES
paramagnetic resonance of trivalent gadolinium ions in octohydrate, zero-field, 16: 16384
NEON
electron transfer collisions near adiabatic conditions with helium ions, and hydrogen atoms and ions, 16: 16868
NEON ISOTOPES Ne-20
neutron reactions (n,α) at 6.2 to 10.7 Mev, 16: 17099
reactions with aluminum, carbon, copper, and tantalum nuclei, nitrogen-17 production, 16: 17153
NEPTUNIUM
elution from anion resin, 16: 16394
NEPTUNIUM ISOTOPES Np-237
alpha decay and thermal neutron fission, nuclear orientation effects, 16: 16061
NERVE CELLS
radiation effects on neuron substructure in rats, 16: 16278
NERVES
electrical activity, effects of alpha particles, 16: 16197
radiation effects on isolated, 16: 16255
radiation effects on electrical characteristics, comparison of ionizing and ultraviolet, 16: 16256
radiation effects on response in frog's muscle to electric stimuli, 16: 16257
radiation effects on presynaptic failure of neuromuscular transmissions, 16: 16258
NERVOUS SYSTEM
conference on effects of radiation, Vienna, June 5 to 9, 1961, 16: 16253
permeability of perilemma, study using carbon-14 labeled sugars, 16: 16117
radiation effects, 16: 16243
radiation effects, aerobic and anaerobic metabolic studies, 16: 16274
radiation effects, 16: 16277
radiation effects on vegetative, 16: 16280
radiation effects in rats, 16: 16282
radiation effects, comparison of response variability and degree of higher activity, 16: 16283
radiation effects at low levels, 16: 16286
radiation effects, hypotheses on action mechanisms, 16: 16288
radiobiology of nervous receptors, 16: 16254
radiotherapy effects on, late, 16: 16207
role in changes of metabolic reactivity of irradiated organisms, 16: 16284
NEUTRON ACTIVATION CROSS SECTIONS
measurement in Project Gnome, 16: 17072 (PNE-113P)
NEUTRON CAPTURE CROSS SECTIONS
statistical theory of radiative, 16: 17070 (NDA-2093-7)
NEUTRON CROSS SECTIONS
bibliography for inelastic scattering and (n,2n) processes, 16: 17074 (VDIT-50)
NEUTRON SHIELDING
calculation methods for accelerators, 16: 17161
materials, evaluation of organic, 16: 17221 (DC-52-5-41)
NEUTRON SOURCES
design for continuous and pulsed operation, 16: 16483
spectra from beryllium–polonium and beryllium–radium, 16: 17060
NEUTRON SPECTRA
measurement in ZEEP by reaction rates with selected nuclides, 16: 17233 (CRRP-985-D)
NEUTRON SPECTROMETERS
development of fast, 16: 16520 (CEA-2002)
NEUTRONS
angular distributions from alpha reactions (α,n) with boron-11, 16: 17119
attenuation in heterogeneous slab lattices, 16: 17237 (NASA-TN-D-1184)
capture by boron-10, applications in therapy of brain tumors, 16: 16215
detection and measurement in bremsstrahlung beam of 22-Mev betatron, 16: 17158 (SCR-481)
detection and measurement, summary of methods for, 16: 17058 (NYO-7877(Rev.1))
detection and measurement with boron trifluoride counters during emission from plutonium billets, 16: 16809 (PG-Report-314)
detection and measurement of delayed fission, in reactor cooling circuits, 16: 16523 (CEA-2101)
dosage determination during zero-power reactor incident, 16: 16618
flux and spectra measurements in void tank irradiation chamber, 16: 17311 (SCR-480)
form factors, theory, 16: 16941 (NP-11592(Vol.I)(p.121-37))
interactions with protons in the pair correlation model, excitation of even-even nuclei by, 16: 17150
interactions with protons and tritons at 14.6 Mev, elastic scattering, 16: 16520 (CEA-2002)
polarization asymmetries from proton reactions (p,n) with lithium-7 at 0.1 to 2.4 Mev, 16: 17091
reactions (n,α) with neon-20 at 6.2 to 10.7 Mev, 16: 17099
reactions with krypton at 6.4 to 12 Mev, disintegration, 16: 17099
reactions with oil and water for measurements of Lid Tank Facility dose-rate measurements, 16: 17064 (CNLM-3244)
role in lithium-6 three-body model, 16: 17079
scattering by helium (liquid), spectra of density fluctuations by excitation in, 16: 17061 (AROD-431:45)
scattering by nuclei (light) at 0.1 to 2.4 Mev, polarization asymmetries in, 16: 17091
transport, computer codes for Monte Carlo calculations, 16: 16633 (DC-59-12-83)
NEW ZEALAND
isotopic ratios in thermal area, 16: 16581
isotopic ratios in thermal area, 16: 16582
tritium levels in waters in, 1956 to 1960, 16: 16078
NICKEL
determination in lithium chloride–potassium chloride eutectic by controlled potential stripping, 16: 16310
solubility in lithium at high temperature, 16: 16689 (TID-7626(Pt.I)(p.143-5))
NICKEL CRYSTALS
radiation effects by electrons at 3 Mev, Kossel patterns in, 16: 16786
NICKEL ISOTOPES Ni-60
energy levels, 16: 17081
NICKEL ISOTOPES Ni-65
beta and gamma spectra and energy levels, 16: 17148
NICKEL STEEL
analysis for molybdenum and tin by solvent extraction and 8-quinolinol, spectrophotometric, 16: 16314
NICKEL–URANIUM ALLOYS
eutectic temperature, 16: 17297(R) (LAMS-2681)
NICKEL–ZINC ALLOYS
phase studies of nitrogen containing, 16: 16768
NIOBIUM
alloying effects on mechanical properties of aluminum-chromium-iron alloy, 16: 17276(P)
alloying effects on mechanical properties of steel, 16: 16737
analysis for tantalum, spectrophotometric, 16: 16313
corrosion by cesium at 1600 to 2500°F, 16: 16684 (TID-7626(Pt.I)(p.109-10))
corrosion by potassium, at 1450 to 2000°F, 16: 16678 (TID-7626(Pt.I)(p.42-62))
determination in concentrates, minerals, and ores by ion exchange, 16: 16312
determination in steel as molybdoniobic acid, spectrophotometric, 16: 16315
determination, pyrogallol complexometric, 16: 16327
hardness, microstructure, and cold working properties of high-purity, effects of carbon, 16: 16747
separation from protactinium, chromatographic, 16: 16396
thermal conductivity at 0.2 to 1.2°K, 16: 16874
NIOBIUM BORIDES

- erosion by gases at 3000°K, 16: 16726(R) (NP-11311)

NIOBIUM CARBIDES
- erosion by gases at 3000°K, 16: 16726(R) (NP-11311)

NIOBIUM COMPLEXES
- with molybdenum, formation and reduction, 16: 16315

NIOBIUM ISOTOPES Nb-95
- beta decay, gamma circular polarization in, 16: 17085
- beta decay, isospin conservation in, 16: 17084
- sorption from aqueous solutions by manganese dioxide, 16: 16389

NIOBIUM ORES
- consumption, occurrence, trade, and uses, 16: 2034
- resources review, 16: 16716 (CNLM-2166)

NIOBIUM OXIDES
- phases, metallographic study, 16: 16745

NIOBIUM OXYCHLORIDES
- thermal dissociation and vapor pressure, 16: 16398

NIOBIUM–RUTHENIUM ALLOYS
- preparation, 16: 16724(R) (NMI-9238)

NIOBIUM–TIN ALLOYS
- superconductivity, 16: 16830

NIOBIUM–TITANIUM ALLOYS
- superconductivity, 16: 16830

NIOBIUM–TITANIUM–VANADIUM ALLOYS
- fabrication and tensile properties, effects of nitrogen and oxygen on, 16: 16712(R) (ARF-2231-3)

NIOBIUM–ZIRCONIUM ALLOYS
- corrosion by cesium at 1600 to 2500°F, 16: 16684 (TID-7626(Pt.I) (p.109-10))
- corrosion by high-temperature potassium, 16: 16680 (TID-7626(Pt.I) (p.69-86))
- corrosion by potassium, at 1450 to 2000°F, 16: 16678 (TID-7626(Pt.I) (p.42-62))
- corrosion by sodium at 1500 to 2400°F, 16: 16677 (TID-7626(Pt.I) (p.23-34))
- creep properties at high temperatures, alloying effects of copper and molybdenum, 16: 16772(P)
- fabrication, melting, welding, and workability, 16: 16716 (CNLM-2166)
- phase diagrams, effects of oxygen, 16: 16719 (EURAEC-137)
- superconductivity, 16: 16830

NITRATES
- salting-out effects in aqueous uranyl nitrate-ether systems, 16: 16462

NITRIC ACID–ZIRCONIUM SYSTEMS
- corrosive effects on titanium, inhibition by chromium(VI)–hydrofluoric acid solutions, 16: 16464

NITROGEN
- collision integrals and potential energy functions with nitrogen oxides and oxygen, 16: 16853
- determination in geothermal bores, fumaroles, and pools in New Zealand, mass spectrometric, 16: 16581
- determination of traces in argon, spectrographic, 16: 16570(P)
- equation of state to 30000°K, 16: 17186
- metabolism during radiation injuries, 16: 16294
- metallurgical effects on hafnium–niobium–vanadium and niobium–titanium–vanadium alloys, 16: 16712(R) (ARF-2231-3)
- radiation effects on availability in soils, 16: 16176 (NP-11578)
- sorption on Vycor porous glass at 77.7°K, 16: 16385

NITROGEN (SOLID)
- nuclear quadrupole resonance of nitrogen-14 in, at 1.5 to 34.5°K, 16: 16354

NITROGEN FLUORIDES
- production of N_2F_2 and N_2F_4, 16: 16402(P)

NITROGEN ION BEAMS (N-14)
- reactions with aluminum, carbon, copper, and tantalum nuclei, nitrogen-17 production, 16: 17153

NITROGEN IONS
- interactions with beryllium and molybdenum, secondary ion emission, 16: 16880

NITROGEN ISOTOPES N-13
- energy levels from proton reactions with oxygen-16 at 146 Mev, 16: 17088

NITROGEN ISOTOPES N-14
- nuclear quadrupole resonance in nitrogen (solid) at 1.5 to 34.5°K, 16: 16354

NITROGEN ISOTOPES N-15
- energy levels from proton reactions with fluorine-19 at 143 Mev, 16: 17088

NITROGEN ISOTOPES N-17
- production by neon-20 and nitrogen-14 reactions with aluminum, carbon, copper, and tantalum, 16: 17153

NITROGEN MUSTARDS
- biological effects in *Escherichia coli*, chemical protection, 16: 16297

NITROGEN OXIDES
- ionization efficiencies, electron impact-induced, 16: 16409(R) (TID-15424)
- potential energy functions with nitrogen and oxygen, 16: 16853

NITROGEN SYSTEMS
- phase studies of transition metal alloy, 16: 16768

NITROSYL CHLORIDES
- use in solar regenerative fuel cell system, 16: 16480 (WADD-TR-60-821(Pt.II))

NORWAY
- geology of base rock, 16: 16577 (TID-14861(Vols.I&II))

NRX REACTOR
- fuel element design and performance, review, 16: 16669
- neutron flux axial distribution and various moderator levels, thermal, 16: 17232 (CRC-1058)

NUCLEAR EMULSIONS
- antiproton scattering cross sections at 0 to 250 Mev, 16: 16922 (AD-261903)
- meson (π^-) absorption and scattering at 5.7 Bev, 16: 16964 (NP-11592(Vol.I)(p.291-4))
- performance, with incorporated filamentary and powdered targets, 16: 16967 (NP-11592(Vol.I)(p.307-25))
- stopping californium-252 fission fragments in Ilford K-5, 16: 17078

NUCLEAR ENGINEERING
- materials handbook, 16: 16036

NUCLEAR MAGNETIC RESONANCE
- theory in paramagnetic media, 16: 16887

NUCLEAR MODELS
- agreement from nucleon indistinguishability in, 17: 17120
- development of generalized cluster, 16: 17073 (SUI-61-6)

NUCLEAR MODELS (OPTICAL)
- potential for rearrangement reactions, 16: 17132

NUCLEAR MODELS (SHELL)
- wave function for l-forbidden beta emission in relativistic, 16: 17122

NUCLEAR PARTICLES
- interactions, theory of strong, 16: 17066 (IA-698)

NUCLEAR PHYSICS
- analysis of new isobaric spin group, 16: 16990 (NP-11592(Vol.I)(p.503-6))
- book: *Group Theory*, 16: 16639
- energy from fission, review, 16: 16655
- singularities in partial wave amplitudes for interactions of two-ingoing and two-outgoing particles, 16: 16970 (NP-11592(Vol.I)(p.337-42))
- theory of selection rule $\Delta Q = \Delta S$, testing, 16: 16953 (NP-11592(Vol.I) (p.209-15))

NUCLEAR POWER
- cost calculations, 16: 16034

NUCLEAR POWER PLANTS
- development for space vehicles, 16: 17327
- supervision, signal recording and display arrangement design for, 16: 16561(P)

NUCLEAR REACTIONS
- analysis, generalized cluster model for, 16: 17073 (SUI-61-6)
- rearrangement in compound and direct, model for, 16: 17132

NUCLEAR THEORY
- dispersive bonding theory, 16: 17031
- mesons and hard core in nuclear forces, 16: 17044
- new symmetries for strong interactions, 16: 17127
- nuclear matter at low density, 16: 17063 (CEA-2086)
- relativistic strong coupling, 16: 17013
- unitary symmetry consequences, 16: 17030

NUCLEI
- beta decay, pseudoscalar interaction in, 16: 17080

data tables, 16: 17154
deuteron elastic scattering by low-mass, cross sections and polarizations in, 16: 17130
electron scattering at 300 to 1000 Mev, proton emission and angular and energy correlations, 16: 17094
energy level structure from electron scattering at 300 to 1000 Mev, 16: 17094
gamma reactions, theory of deuteron production in, 16: 17071 (NP-11564)
ion reactions with heavy and medium, heavy, 16: 17134
mass tables, 16: 17087
mass tables, relative, 16: 17086
meson (K^-) absorption, hyperon effects, 16: 16980 (NP-11592(Vol.I)(p.389-94))
nucleon pairing force ratio to field-producing force in, 16: 17106
nucleon reactions at intermediate energies, model for, 16: 17131
nucleon scattering at high energies, Pauli exclusion effects in, 16: 17121
nucleon scattering cross sections, channel coupling in, 16: 17101
nucleon scattering, cross section relation to optical potential imaginary component, 16: 17104
particle reabsorption, fast secondary, 16: 17123
quadrupole excitations of even-even spherical, by proton-neutron interactions, 16: 17150
reactions with nuclei at high energies, inelasticity in, 16: 16920
rotational potentials, Hartree-Fock equations in, 16: 17102
spectra of deformed even, one-parameter description of collective, 16: 17108
surface properties, determination by low-energy particles, 16: 16811(R) (PR-P-52)
transitions (E1) in Z = 30, 63, and 82, positron formation in, 16: 17098

NUCLEI (CELLS)
radiosensitivity of enzymes, 16: 16219

NUCLEONS
indistinguishability in nuclei, nuclear-model agreement from, 16: 17120
interactions, dispersion theory of, 16: 17038
interactions in carbon, ratio of charged to neutral, 16: 17114
interactions in nuclei, pairing force ratio to field-producing force, 16: 17106
interactions with primary and secondary particles, 16: 17123
interactions with scalar mesons, solution of low equation, 16: 17224
interactions with mesons (π), phase-space integral for 25 Bev collision, 16: 17020
interactions with mesons (π) and photons, coincidence measurements from, 16: 17036
interactions with mesons (K^-), cross-section maxima in, 16: 17043
interactions with antinucleons and nucleons, core phenomena in, 16: 17044
interactions with mesons (π), phenomenological description, 16: 17052
interactions with nucleons, intermediate region potential, 16: 16972 (NP-11592(Vol.I)(p.347-9))
interactions with mesons (π), phase shifts at 0 to 350 Mev, 16: 16988 (NP-11592(Vol.I)(p.461))
interactions with mesons (π), at 400 to 1500 Mev mechanisms, 16: 16989 (NP-11592(Vol.I)(p.467-83))
interactions with mesons (π) at 20 Bev, photon emission in, 16: 17014
interactions with hyperons (Λ), binding energies, 16: 17015
meson (π) forward scattering, dispersion relations, 16: 16991 (NP-11592(Vol.I)(p.485-6))
meson spectrum in fast, peripheral, 16: 17016
properties of isobaric, 16: 16998 (NP-11592(Vol.II)(p.57-85))
reactions with nuclei at intermediate energies, model for, 16: 17131
resonances and threshold mass numerologies in, 16: 17028
resonances as unitary multiplets, 16: 17029
scattering by nuclei at high energies, Pauli exclusion effects in, 16: 17121
scattering by nuclei, cross section relation to channel coupling, 16: 17101
scattering by nuclei, cross section relation to optical potential imaginary component, 16: 17104
structure, electromagnetic aspects, 16: 16997 (NP-11592(Vol.II)(p.33-55))
structure, theory, 16: 16941 (NP-11592(Vol.I)(p.121-37))
structure, theory of electric, 16: 16996 (NP-11592(Vol.II)(p.21-31))

NYASALAND
radioactive geological areas on Chilwa Island, effects on population, 16: 16173

O

OCTANE
exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344

OIL DEPOSITS
water flow distributions in, tracer studies, 16: 16074

OILS
electrokinetic and sedimentation properties of additive-containing, 16: 16064

ORGANIC COMPOUNDS
analysis for chlorine, x-ray absorption, 16: 16311
radiation effects, 16: 17221 (DC-52-5-41)
radiolysis, isotope effects of deuterium and tritium in, 16: 16086

ORGANIC MODERATED REACTOR EXPERIMENT
coolant energy absorption rates in, 16: 17236 (NAA-SR-6893)
fuel element design and performance, review, 16: 16669

ORGANS
radiotherapy effects on internal, late, 16: 16207

ORNL GRAPHITE REACTOR
fuel element design and performance, review, 16: 16669

OSMIUM
film production by cathodic sputtering, chamber design for thin, 16: 16433

OSMIUM FLUORIDES
physical properties, 16: 16464

OSMIUM ISOTOPES Os-186
energy levels, 16: 17081
excited state spectrum, first, 16: 17108

OSMIUM ISOTOPES Os-187
determination in meteoritic and terrestrial osmium, 16: 16040

OSMIUM ISOTOPES Os-188
energy levels, 16: 17081
excited state spectrum, first, 16: 17108

OSMIUM ISOTOPES Os-190
energy levels, 16: 17081
excited state spectrum, first, 16: 17108

OSMIUM ISOTOPES Os-192
excited state spectrum, first, 16: 17108

OXYGEN
collision integrals and potential energy functions with nitrogen and nitrogen oxides, 16: 16853
determination in alkali metals, method development, 16: 16687 (TID-7626(Pt.I)(p.130-40))
determination in geothermal bores, fumaroles, and pools in New Zealand, mass spectrometric, 16: 16581
determination in potassium, methods review, 16: 16686 (TID-7626(Pt.I)(p.128-9))
determination in sodium, 16: 16689 (TID-7626(Pt.I)(p.143-5))
determination in sodium, methods evaluation, 16: 16688 (TID-7626(Pt.I)(p.141-2))
electron transfer collisions near adiabatic conditions with argon, krypton, and xenon, 16: 16868
electronic energy of molecular, 16: 16357
equation of state to 30000°K, 16: 17186
metallurgical effects on hafnium–niobium–vanadium and niobium–titanium–vanadium alloys, 16: 16712(R) (ARF-2231-3)
metallurgical effects on niobium–zirconium phase diagrams, 16: 16719 (EURAEC-137)
neutron reactions, removal cross sections, 16: 17064 (CNLM-3244)
neutron removal cross sections, 16: 17059
oxidation of uranium, structure relation in formation of embryos by cathodic, 16: 16694
potential energy curves for diatomic, 16: 16821

OXYGEN IONS
interactions with beryllium and molybdenum, secondary ion emission, 16: 16880

ionization efficiency of negative in nitrous oxide, 16: 16409(R) (TID-15424)
thermodynamic equilibrium in chromosphere, departures from, 16: 16898
OXYGEN ISOTOPES O-14
beta decay, polarization of positrons from, 16: 16059
OXYGEN ISOTOPES O-15
energy levels from proton reactions with fluorine-19 at 143 Mev, 16: 17088
energy levels from proton reactions with oxygen-16 at 146 Mev, 16: 17088
OXYGEN ISOTOPES O-16
energy levels from proton reactions with fluorine-19 at 143 Mev, 16: 17088
neutron scattering at 0.1 to 2.4 Mev, polarization asymmetries, 16: 17091
nucleon scattering at high energies, Pauli exclusion effects in, 16: 17121
proton reactions at 146 Mev, gamma emission in, 16: 17088
OXYGEN ISOTOPES O-17
energy levels, calculation of single-particle, 16: 17152
OXYGEN–XENON SYSTEMS
electron transfer collisions near adiabatic conditions, 16: 16868
OXYTOCINS
protective effects against radiation sickness in mice, 16: 16199

P

PACIFIC OCEAN
silts accumulation rates in, thorium-230/thorium method for determination, 16: 16583
PACKED COLUMNS
development of cellulose acetate–dithizone, for separation of indium, 16: 16319
evaluation for separation of hydrogen, tritium, and tritium hydride, 16: 16085
PAIR PRODUCTION
model for very-high–energy, field theoretical, 16: 16950 (NP-11592 (Vol.I)(p.191-5))
PALLADIUM
atomic magnetic moments in iron–palladium alloys, 16: 16838
solubility in lead–zinc alloys(liquid), 16: 16464
PALLADIUM ISOTOPES Pd-105
abundance ratio to silver-107, relation to solar-system age, 16: 16901
production rate ratio to palladium-107, relation to solar-system age, 16: 16901
PALLADIUM ISOTOPES Pd-106
energy levels, 16: 17081
excited state spectrum, first, 16: 17108
PALLADIUM ISOTOPES Pd-107
production rate ratio to palladium-105, relation to solar-system age, 16: 16901
PALLADIUM ISOTOPES Pd-108
excited state spectrum, first, 16: 17108
PALLADIUM ISOTOPES Pd-109
beta decay gamma spectra, 16: 17125
PALLADIUM ISOTOPES Pd-110
excited state spectrum, first, 16: 17108
PALLADIUM ISOTOPES Pd-111
beta decay gamma spectra, 16: 17125
PARAFFIN
gamma and neutron attenuation, calculation methods for, 16: 17161
PARAMAGNETIC MATERIALS
nuclear magnetic moments in, method for determination, 16: 17155
nuclear magnetic resonance, theory, 16: 16887
PARTICLES
pulmonary deposition and clearance, tracer study using whole-body counting, 16: 16149
size distribution measurement, centrifuge apparatus, 16: 16491(P)
PEACH BOTTOM POWER REACTOR
annuli resonance integral calculations, review of methods for treating geometric effects in, 16: 17295 (GAMD-2660)
development, summary for Oct. to Dec. 1961, 16: 17293(R) (GA-2861)
plenum to reflector block seal design criteria, 16: 17294 (GAMD-1375)
PENNSYLVANIA (LEBANON CO.)
magnetite age in, 16: 16577 (TID-14861(Vols.I&II))
PERCHLORIC ACID
oxidation-reduction potential of uranium(IV)–uranyl system in, effects of temperature on, 16: 16364
PERSONNEL
employment opportunities in atomic energy, 16: 16031 (TID-14314)
PERTURBATION THEORY
generalized master equations, 16: 16637
n-particle system properties in common potentials with two-particle interactions, 16: 17112
S-matrix, models of local non-causal current operators in, 16: 17022
structure of S-matrix singularities, analyticity and unitarity, 16: 17021
vector field canonical commutation relations, consistency with, 16: 17017
PHANTOMS
preparation of tissue-equivalent gel head, 16: 16215
use for dose absorption measurements, 16: 16567(P)
PHARMACEUTICALS
preparation of labeled by neutron bombardment, 16: 16443
PHENANTHRENE
exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344
PHENANTHROLINE COMPLEXES
with beryllium, colors, 16: 16382
PHENOL
exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344
PHENOTHIAZINE, 3-CHLORO-10-(3′-DIMETHYLAMINOPROPYL)-
protective effects against nitrogen mustard and radiation in *E. coli*, 16: 16297
PHENYL ETHER
exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344
PHOSPHATE COMPLEXES
with strontium, ion-exchange study of nature and stability, 16: 16399
PHOSPHATES
excretion and incorporation of labeled, in aphids, 16: 16122
PHOSPHATIDES
thoracic ganglion fractions in Dieldrin resistant and susceptible houseflies, 16: 16118
PHOSPHINES
rotational states of molecules in rare gas crystals, 16: 16330 (AD-264708)
PHOSPHONATES
hydrogen 2-ethylhexyl-phenacyl-, solvent properties for lanthanum, samarium, and yttrium, 16: 16366
solvent properties for uranium, 16: 16464
PHOSPHORS
construction and characteristics of packaged self-luminous promethium-147-activated, 16: 16621
design of composite, for tracking particles, 16: 16893(P)
energy propagation in, 16: 16861
glass, characteristics for continuous measurement of diffusion coefficients of gases in liquids, 16: 16351
plastic block, gamma spectra, 16: 16137
plastic, use in environs monitoring, 16: 16614
preparation and properties of glasses containing cerium, 16: 16892(P)
preparation and properties of cerium oxide-containing glass, 16: 16894(P)
radiation effects survey, 16: 16792
PHOSPHORS (LIQUID)
gamma spectra, 16: 16136
phosphorescence in, 16: 16095
solvent systems for body fluids and tissues, 16: 16166
PHOSPHORUS
movement through ecosystem of cold-water trout stream, tracer studies, 16: 16172(R) (TID-15385)
radiation effects on availability in soils, 16: 16176 (NP-11578)
reactions with metals, up to 700°C, 16: 16054
segregation in welds in stainless steel, 16: 16052
PHOSPHORUS ACIDS

preparation of carbon-14 labeled O-O-diethyl-O-2-pyrazinglphosphorthionate for counting, 16: 16412

PHOSPHORUS COMPOUNDS

organic insecticides, metabolism in plants, 16: 16112

organic insecticides, metabolism mechanisms in animals, 16: 16113

reactions with metals, up to 700°C, 16: 16054

PHOSPHORUS ISOTOPES P-30

energy levels from silicon-29 (p,γ) reactions, 16: 17145

PHOSPHORUS ISOTOPES P-31

proton reactions (p,γ) at 355 and 440 kev, gamma spectra from, 16: 17090

PHOSPHORUS ISOTOPES P-32

atmospheric distributions and fall-out of cosmic-ray-produced, 16: 16587

atmospheric distribution and fall-out of cosmic-ray-produced, 16: 16589

atmospheric production and fall-out of cosmic-ray-produced, 16: 16585

beta emission, lifetime for l-forbidden, 16: 17122

beta spectrum, deviations from the allowed form, 16: 17143

bremsstrahlung spectra from, internal, 16: 17107

chemical state in proton irradiated potassium chloride crystals, 16: 16411(T) (AEC-tr-5055)

decay, distribution, and persistence in cockroach and grasshopper, 16: 16119

turnover in phospholipid fractions in Dieldrin resistant and susceptible houseflies, 16: 16118

uses in metabolism studies of organophosphate insecticides in plants, 16: 16112

PHOSPHORUS ISOTOPES P-33

atmospheric distributions and fall-out of cosmic-ray-produced, 16: 16587

atmospheric distribution and fall-out of cosmic-ray-produced, 16: 16589

atmospheric production and fall-out of cosmic-ray-produced, 16: 16585

PHOTOELECTRIC CELLS

development of metal–semiconductor, 16: 16518 (ASD-TR-61-564)

PHOTOGRAPHIC EMULSIONS

granulometric analysis, method, 16: 16362

PHOTOGRAPHIC FILM

density measurement of badges, apparatus for automatic, 16: 16564(P)

PHOTOGRAPHIC FILM DETECTORS

calibration of fast neutron, 16: 16615

PHOTOGRAPHY

techniques in nuclear explosions, 16: 16528 (VUP-2202)

use in study of underground explosions, 16: 16033(T) (UCRL-Trans-806(L))

PHOTOMULTIPLIER TUBES

development for scintillation counting of tritium, 16: 16094

developments for liquid scintillation tritium counting, 16: 16092

performance with gamma spectrometers for whole-body counting, 16: 16141

testing, gallium phosphide diode for, 16: 16551

uses in scintillation apparatus, 16: 16531(T) (UCRL-Trans-786(L))

PHOTONEUTRONS

angular distribution from bismuth-209, forward asymmetry, 16: 17089

polarization in deuteron photodisintegration at 11.0 to 22.9 Mev, 16: 16924 (NP-11509)

yield from erbium and holmium, 16: 17083

PHOTONS

absorption by nuclei, giant resonance in dipole, 16: 17109

emission in meson (π)-nucleon interactions at 20 Bev, 16: 17014

interactions with nucleons, coincidence measurements from, 16: 17036

interactions with highly relativistic elementary particles, 16: 16950 (NP-11592(Vol.I)(p.191-5))

production by proton-proton interactions at 23.1 Bev, 16: 16934 (NP-11592(Vol.I)(p.73-7))

reactions with bismuth-209, neutron angular distribution forward asymmetry in, 16: 17089

reactions with erbium and holmium at 8 to 19 Mev, cross sections and neutron yields for, 16: 17083

transport, computer codes for Monte Carlo calculations, 16: 16633 (DC-59-12-83)

PHYSICS

book: *Methods of Mathematical Physics. II.*, 16: 16640

developments in electromagnetic effects, 16: 17183(T) (JPRS-12990)

dynamics, analysis of constancy and similarities, 16: 17174 (AD-266636)

spin Hamiltonian, eigenvalues and induced transition probabilities for anistropic, 16: 16516 (AFOSR-1794(p.1-14))

thermodynamic properties of exchange-coupled atoms, 16: 16802 (AFOSR-1934)

PHYSIOLOGY

radiation effects on *Neurospora crassa*, cosmic, 16: 16191

PINCH EFFECT

use in space vehicle propulsion, 16. 17320 (PPL-116)

PIQUA POWER REACTOR

coolant energy absorption rates in, 16: 17236 (NAA-SR-6893)

PITCHBLENDES

analysis for radiogenic lead, mass spectrometric, 16: 16825

processing for technetium-99 isolation, 16: 16369

PITOT TUBES

design and performance for measuring velocity distribution in water stream between two vertical parallel plates, 16: 16510

PLANETS

flight to Mars, analysis of straight-line, 16: 17326

PLANTS

metabolism of organophosphate insecticides, 16: 16112

radioinduced genetic changes, use in production of new varieties, 16: 16205

PLASMA

amplifiers, design of negative-resistance, 16: 17189

book: *Theory of Waves in Plasma*, 16: 17211

boundary layer in electric discharge at low pressures, 16: 17201

charged particle motion in inhomogeneous magnetic field, 16: 17197

charged particle transition radiation in, 16: 17207

compression in cavity resonator by h-f electromagnetic field, 16: 17217(P)

containment by magnetic mirrors and uhf electromagnetic waves, 16: 17215(P)

containment in magnetic field, theory, 16: 17330

density, ion gage for measuring neutral gas, 16: 17202

dielectric breakdown using secondary electrons at 10^{-4} mm mercury, 16: 16801 (AFCRL-62-239)

diffusion across magnetic fields, 16: 17175 (AFCRL-1028)

electric conductivity and electron relaxation in a strong magnetic field, radiation effects on, 16: 17209

electric potential, probe design and performance using electron time-of-flight, 16: 17203

electromagnetic wave propagation in nonlinear conducting, 16: 17199

electron beam interactions, 16: 17178 (ML-793)

electron density and temperature measurement with optical maser beam, 16: 17191

electron energy distribution determination by Langmuir probe, corrections for, 16: 16553

electron mobility measurements according to resistance variation in a magnetic field, 16: 17205

equation of state to 30000°K, 16: 17186

excitation by charged particle beams, 16: 17185(T) (JPRS-12990 (p.367-71))

magnetic flux diffusion in one dimensional compressible and resistive, 16: 17198

microwave properties, 16: 17178 (ML-793)

model of identical charge sheets embedded in uniform fixed neutralizing background, one-dimensional, 16: 17195

oscillations in relativistic, 16: 17196

oscillations of anisotropic, collective energy losses in, 16: 17208

oscillations, relativistic limits to non-linear electron, 16: 17192

oscillations, with unstable distribution function, 16: 17210

potential measurements using lithium ion beams, 16: 17187

production, destruction of neutral particles, 16: 17218(P)

production in cesium thermionic converters, 16: 16800(R) (AD-266440)

production of high-density by magnetic compression, 16: 17177 (JÜL-36-PP)

rarefaction criterion, theory, 16: 17180 (USCEC-83-212)

shock wave propagation in collisionless, 16: 16913

shock wave properties in collisionless, 16: 16912

shock waves in, converging, 16: 17190

stability, effects of high-frequency electromagnetic disturbances,

16: 17184(T) (JPRS-12990(p.54-75))
stability in a toroidal discharge excited by a traveling electromagnetic field, 16: 17206
stability in homogeneous magnetic field, 16: 17193
stability of toroidal, against disturbances independent of azimuth, 16: 17194
wave propagation in two component, with anisotropic pressure tensor, 16: 17200

PLASMA JETS
electric conductivity measurements of arc, 16: 17314(R) (AD-266439)
generation and acceleration by stationary field induction coil, 16: 17321
production, ionization chamber design for, 16: 17216(P)
propulsion kinetics, 16: 17320 (PPL-116)

PLATES
magnetohydrodynamic boundary layer flow of incompressible conducting fluid past magnetized, 16: 16512

PLATINUM
analysis for ruthenium by neutron activation, 16: 16326
atomic magnetic moments in binary alloys with chromium and manganese, 16: 16838
characteristics as radiation target, incorporated into nuclear emulsion, 16: 16967 (NP-11592(Vol.I)(p.307-25))

PLATINUM FILMS
fission-product effects in, 16: 16787

PLATINUM ISOTOPES Pt-192
energy levels, gamma–gamma directional correlations in, 16: 17116
excited state spectrum, first, 16: 17108

PLATINUM ISOTOPES Pt-194
energy levels, 16: 17081
gamma angular correlations in, 16: 17118

PLATINUM ISOTOPES Pt-196
energy levels, 16: 17081
excited state spectrum, first, 16: 17108

PLATINUM ISOTOPES Pt-198
neutron capture, rate measurements, 16: 17233 (CRRP-985-D)

PLOWSHARE PROJECT
firing and timing for Project Gnome, 16: 16029 (PNE-115P)
ground motion at Carlsbad, New Mexico from Project Gnome, 16: 16576 (PNE-129F)
ground surface motion in Project Gnome, photography, 16: 16528 (VUP-2202)
resonance neutron activation measurements in Project Gnome, 16: 17072 (PNE-113P)
structure surveys before and after Project Gnome shot, 16: 16608 (PNE-127P)

PLUTONATES
solubility in aqueous solutions, 16: 16393

PLUTONIUM
metallurgy and properties, review, 16: 16658
neutron emission from billets, measurements with boron trifluoride counters, 16: 16809 (PG-Report-314)
preparation and properties, survey, 16: 16036
production at Marcoule, safety apparatus for radioactive accidents in, 16: 16597 (CEA-2113)
radiolysis of aqueous solutions, 16: 16420
separation from aqueous solutions by peroxide precipitation, 16: 16468(P)
separation from fission products by volatilization and liquation, 16: 17297(R) (LAMS 2681)
solvent properties for aluminum, 16: 16750

PLUTONIUM ALLOYS
metallurgy and properties, review, 16: 16658

PLUTONIUM(III) CHLORIDES
reactions with alkali chlorides and chlorine gas, formation of plutonium(IV) ions by, 16: 16367

PLUTONIUM(IV) FLUORIDES
solubility in sodium fluorides, 16: 16392

PLUTONIUM HYDROXIDES
formation in hydrolized solutions, 16: 16393

PLUTONIUM(IV) IONS
formation in binary solutions of alkali chlorides with plutonium(III) chlorides, 16: 16367

PLUTONIUM ISOTOPES Pu-238
excited state spectrum, first, 16: 17108
properties as heat sources, 16: 16464

PLUTONIUM ISOTOPES Pu-239
determination in man, partial-body counting, 16: 16148
neutron capture, rate measurements, 16: 17233 (CRRP-985-D)

PLUTONIUM ISOTOPES Pu-240
excited state spectrum, first, 16: 17108

PLUTONIUM OXIDE–URANIUM OXIDE SYSTEMS
phase equilibria of powders, effects of argon and hydrogen sintering on, 16: 16753

PLUTONIUM OXIDES
behavior, preparation, and structure, review, 16: 16660

PLUTONIUM PEROXIDES
precipitation from aqueous solutions, 16: 16468(P)

PLUTONYL IONS
hydrolysis, 16: 16393

POLONIUM ISOTOPES
monitoring in Antarctica between 60°N and 70°S in 1958, 16: 16042

POLONIUM ISOTOPES Po-210
properties as heat sources, 16: 16464

POLONIUM ISOTOPES Po-212
energy levels from bismuth-212 decay, 16: 17082

POLYMERS
Mossbauer effect in tin-bearing, 16: 16889
radiation effects in engineering uses, 16: 16625
radioinduced crosslinking, efficient, 16: 16446(P)
radioinduced graft polymerization of vinyl amides on synthetic condensation, 16: 16448(P)

POLYSACCHARIDES
effects of zymosan on phagocytic activity of reticulo-endothelial system, 16: 16226

POPULATIONS
control of insect, role of radioinduced lethal mutations in, 16: 16129
genetic data processing, 16: 16225
radiation injuries determined by hematological values, 16: 16238

POROSITY
measurement, development of mercury porosimeter based on capillary depression phenomenon for, 16: 16521 (CEA-2093)

POROUS MATERIALS
sorption of helium and nitrogen on Vycor glass, 16: 16385

PORTUGAL
sand movement on seaside near Povoa do Varzim, tracer study, 16: 16586

POSITRONIUM
lifetimes and populations of singlet and triplet states, in magnetic fields, 16: 16965 (NP-11592(Vol.I)(p.295-9))
scattering low-energy ortho-, by helium, 16: 16870

POSITRONS
annihilation cross sections in flight at 2 to 10 Bev, 16: 16946 (NP-11592(Vol.I)(p.151-3))
annihilation in lithium hydride at 15 Mev, photon line width produced by, 16: 17012
branching ratios in lead-205 level decay, 16: 17096
branching ratios in samarium-152 level decay, 16: 17097
emission in thallium-200 decay, branching ratio to electron (K) capture, 16: 17113
interactions with electrons, research on production of collisions at 500 Mev and 1 Bev c.m. energy, 16: 16992 (NP-11592(Vol.I)(p.487-501))
polarization measurement, 16: 16965 (NP-11592(Vol.I)(p.295-9))
production in K-shell de-excitation, 16: 17098

POTASSIUM
analysis for oxygen, methods review, 16: 16686 (TID-7626(Pt.I)(p.128-9))
determination of total-body, in man by whole-body counting of potassium-40, 16: 16151
effects of dietary levels on metabolism of cesium-137, 16: 16152
emission spectra at high temperatures, pressure effects on, 16: 16819
magnetic spin susceptibility and thermal conductivity, 16: 16713 (AROD-431:44)
radiation effects on availability in soils, 16: 16176 (NP-11578)
self-diffusion in melts containing silica and sodium oxide, lithium oxide, calcium oxide, and potassium oxide, 16: 16048
separation from cadmium by coprecipitation with cadmium–cerium alloy,

16: 16464

POTASSIUM (LIQUID)
- corrosive effects on refractory alloys at high temperature, 16: 16679 (TID-7626(Pt.I)(p.63-8))
- corrosive effects on Haynes 25 alloy at high-temperatures, 16: 16680 (TID-7626(Pt.I)(p.69-86))
- corrosive effects on niobium and niobium-zirconium alloys at 1450 to 2000°F, 16: 16678 (TID-7626(Pt.I)(p.42-62))
- thermophysical properties, 16: 16741

POTASSIUM CHLORIDE CRYSTALS
- radiolysis, phosphorus-32 chemical state in proton, 16: 16411(T) (AEC-tr-5055)
- thermal conductivity, effects of imperfections, 16: 16058

POTASSIUM CHLORIDES
- activity coefficients in methanol–water mixture at 25°C, rule for calculation, 16: 16375
- reactions with plutonium(III) chlorides and chlorine gas, formation of plutonium(IV) ions by, 16: 16367

POTASSIUM COMPLEXES
- with nitratonitrosylruthenium anions and complexes, preparation and composition, 16: 16381

POTASSIUM FORMATES
- radiolysis, spectra of CO$_2^-$ radical in, 16: 16435

POTASSIUM ISOTOPES K-40
- determination in man, whole-body counting, 16: 16139
- determination in man, whole-body counting, 16: 16151
- determination in man, effects of diseases on total-body levels, 16: 16157

POTASSIUM ISOTOPES K-42
- penetration of nerve cord in cockroach, 16: 16117

POTASSIUM NITRATES
- radiolysis, effects of intensity on, 16: 16425

POTASSIUM OXALATES
- radiolysis, spectra of CO$_2^-$ radical in, 16: 16435

POTASSIUM OXIDES
- diffusion of calcium, potassium, and sodium ions in, in melts with silicon oxide–sodium oxide systems, 16: 16048

POTASSIUM PERMANGANATES
- Szilard–Chalmers reaction at low temperature, 16: 16423

POTASSIUM SALTS
- determination and prospecting in bore-holes by logging methods, 16: 16044

POTASSIUM–SODIUM ALLOYS (LIQUID)
- corrosive effects on Hastelloy X and stainless steel at 1100 to 1500°F, 16: 16691 (TIM-435)
- corrosive effects on Hastelloy and Haynes 25 alloy at 1200 to 1500°F, 16: 16681 (TID-7626(Pt.I)(p.87-91))

POWER CYCLES
- development of Joule, for space vehicle electric power, 16: 17322

POWER REACTORS
- pressure vessel fabrication for SENN, by forging, 16: 17303

PRASEODYMIUM
- nuclear magnetic moments, spin-orbit coupling, and hyperfine fields, 16: 16831
- separation from cadmium by coprecipitation with cadmium–cerium alloy, 16: 16464

PRASEODYMIUM ISOTOPES Pr-141
- nuclear magnetic moments, 16: 16831

PRASEODYMIUM RUTHENATES
- magnetic susceptibility at 2 to 1300°K, 16: 16837

PRASEODYMIUM SULFIDES
- thermal properties of semiconducting at 800°K, 16: 16799(R) (AD-265462)

PRECIPITATES
- radioactivity measurements, production of uniform layers by means of centrifugal force for, 16: 16427

PRESSURE REGULATORS
- design of high-pressure gas, 16: 16569(P)

PRESSURE VESSELS
- design of autoclaves for high-temperature high-pressure gas bonding, 16: 16701
- design of strengthened reactor, 16: 17250(P)
- fabrication from forged components, 16: 17303
- heat treatment, 16: 16702
- radiation damage assessment by nondestructive techniques, 16: 16791
- stress analysis of cylindrical, with ellipsoidal head and short head-to-cylinder transition section, 16: 16478 (TIM-408)
- thermal insulation of nozzles in, 16: 17260(P)

PRESSURIZED WATER REACTORS
- design of small, for transportation, 16: 17283(P)
- fuel cycle costs, effects of uranium-235 price reduction, 16: 17298 (ORNL-TM-191)
- reactivity control, 16: 17269(P)

PRINCETON SYNCHROTRON
- magnet power regulation system for, 16: 17157 (PPAD-442D)

PRODUCTION REACTORS
- water-4, purification by ion exchange, 16: 16335(R) (DP-678)

PROLINE
- determination in protein hydrolyzates using carbon-14 or tritium labeled 1-fluoro-2,4-dinitrobenzene, 16: 16089

PROMETHIUM ISOTOPES Pm-144
- isomers, existence of new short-period metastable, 16: 17147

PROMETHIUM ISOTOPES Pm-147
- properties as heat sources, 16: 16464

PROMPT NEUTRONS
- lifetime calculations, computer program for, 16: 16632 (ANL-6511)

PROPANE
- reactions with iodine in gaseous phase, photochemical, 16: 16339(R) (TID-15369)

PROPANE, 1-CHLORO-
- radiolysis, 16: 16339(R) (TID-15369)

2-PROPANOL
- reactions with iodine, free radicals produced in, 16: 16339(R) (TID-15369)

1-PROPANOL, 2,3-DIMERCAPTO-
- protective effects against radiation injuries and nitrogen mustard in *E. coli*, 16: 16297

PROPORTIONAL DETECTORS
- characteristics and construction of 4π, for beta-gamma coincidence counting, 16: 16543
- performance for partial-body measurement of plutonium-239, 16: 16148
- transistorized preamplifier and voltage sub-unit designs for, 16: 16535

PROPULSION
- by contained nuclear explosions, 16: 17328
- ion systems, use on space missions, 16: 17324
- space vehicles, use of pinch effect in, 16: 17320 (PPL-116)

PROPYLAMINE
- quenching properties of iso-, for use in Geiger counters, 16: 16101

PROSPECTING
- nuclear-physical methods in, review, 16: 16043

PROTACTINIUM
- separation from niobium, titanium, and zirconium, chromatographic, 16: 16396
- sorption on glass and metals, 16: 16388

PROTACTINIUM IONS
- properties of pentavalent, in sulfuric acid solutions, 16: 16365

PROTACTINIUM ISOTOPES Pa-228
- decay scheme, 16: 16536

PROTEINS
- analysis of hydrolyzates, for amino acids using carbon-14 or tritium labeled 1-fluoro-2,4-dinitrobenzene, 16: 16089
- metabolism, tracer study, 16: 16159
- radioinduced oxidation in aqueous solutions, 16: 16439
- separation of thermostabile glycoprotein from fibrinogen lysate, 16: 16104 (PAN-252/X)

PROTON BEAMS
- biological effects of collimated monoenergetic, in brain, 16: 16248
- depolarization in synchrocyclotron, resonance effects on, 16: 17167
- use in irradiation of small brain areas in treatment of certain nervous and psychic disorders, 16: 16246

PROTONS
- capture (p,γ) by magnesium-25 at 0.95 to 1.80 Mev, gamma spectra from, 16: 17103
- capture (p,γ) by deuterium at 0.275 to 1.75 Mev, cross sections and

gamma angular distributions in, 16: 17010
coincidence counting, time-to-height pulse converter for, 16: 16547
effects on eyes in Macaca mulatta primates at 730 Mev, relative biological, 16: 16193
emission in electron scattering by nuclei at 300 to 1000 Mev, angular and energy correlations, 16: 17094
emission in electron scattering by calcium-40, 16: 17095
form factors, from electron–proton scattering cross sections, 16: 16942 (NP-11592(Vol.I)(p.139-40))
gamma reactions at 910 Mev, photoproton polarization, 16: 16927 (NP-11592(Vol.I)(p.17-20))
gamma reactions (γ,η,π^+) at 600 to 800 Mev, 16: 16928 (NP-11592 (Vol.I)(p.21-4))
interactions with neutrons in the pair correlation model, excitation of even-even nuclei by, 16: 17150
interactions with mesons (K^-), transition matrix for, 16: 17040
interactions with mesons (K^-) at 1.1 to 1.4 Bev/c, (Σ)-(K^-) relative parity in, 16: 17042
interactions with mesons (K^+), amplitude studies by dispersion relations, 16: 17047
interactions with protons at 2.8 Bev, elastic, 16: 17050
interactions with mesons (π^+), cross section for production of mesons (π) at 310 Mev, 16: 16929 (NP-11592(Vol.I)(p.25-6))
interactions with mesons (π^+) at 310 Mev, mesons (π) production, 16: 16930 (NP-11592(Vol.I)(p.27-35))
interactions with mesons (π^-) at 300 to 1600 Mev, total cross section for neutral processes, 16: 16932 (NP-11592(Vol.I)(p.45-55))
interactions with protons at 23.1 Bev, photon production, 16: 16934 (NP-11592(Vol.I)(p.73-7))
interactions with protons at 24 and 19.8 Bev, scattering cross sections, 16: 16936 (NP-11592(Vol.I)(p.85-91))
interactions with mesons (π^-) at 16 and 24 Bev, cross section for strange particle production, 16: 16937 (NP-11592(Vol.I)(p.93-100))
interactions with protons at 24 Bev, cross section for strange particle production, 16: 16937 (NP-11592(Vol.I)(p.93-100))
interactions with mesons (π^-) near 900 Mev, strange particle distributions, 16: 16952 (NP-11592(Vol.I)(p.203-7))
interactions with mesons (K_1^0) at 200 to 600 Mev, 16: 16955 (NP-11592 (Vol.I)(p.235-9))
interactions with mesons (π^-) at 1.89 Bev, 16: 16958 (NP-11592(Vol.I) (p.249-56))
interactions with mesons (π^-) at 1.6 Bev/c, resonance effects, 16: 16959 (NP-11592(Vol.I)(p.257-64))
interactions with mesons (π^-) at 1.25 Bev, π–π resonance values, 16: 16960 (NP-11592(Vol.I)(p.265-7))
interactions with antiprotons at 0.58 to 5.3 Bev, 16: 16963 (NP-11592 (Vol.I)(p.283-6))
interactions with mesons (π^-) at 1.6 Bev/c, strange particle distributions from, 16: 16978 (NP-11592(Vol.I)(p.375-83))
interactions with mesons (π^-) at 1 to 5 Bev/c, hyperon production, 16: 16979 (NP-11592(Vol.I)(p.385-8))
interactions with protons at 24 Bev, 16: 16982 (NP-11592(Vol.I)(p.407-17))
interactions with protons at 24 Bev, meson (π) production, 16: 16984 (NP-11592(Vol.I)(p.433-47))
interactions with mesons (π^-) at 6 and 18 Bev, 16: 16985 (NP-11592 (Vol.I)(p.449-52))
interactions with mesons (π^-) at 6.1 and 18.1 Bev, jet distribution, 16: 16986 (NP-11592(Vol.I)(p.453-7))
interactions with neutrons at 14.6 Mev, elastic scattering, 16: 16520 (CEA-2002)
proton reactions (P,π^+) and (P,π^-) at 2.1 and 2.9 Bev, 16: 16933 (NP-11594(Vol.I)(p.57-67))
reactions (p,γ) with phosphorus-31 at 355 and 440 kev, gamma spectra from, 16: 17090
reactions (p,n) with lithium-7 at 0.1 to 2.4 Mev, neutron polarization asymmetries from, 16: 17091
reactions with fluorine-19 and oxygen-16 at 143 and 146 Mev respectively, 16: 17088
role in lithium-6 three-body model, 16: 17079
scattering by hydrogen nuclei at 24.5 Bev, 16: 16939 (NP-11592 (Vol.I)(p.111-15))
scattering by mesons (π^-), and (π^+) at 500 to 1100 Mev, 16: 16931 (NP-11592(Vol.I)(p.37-43))
scattering by protons, small angle data at 1.3, 2.0, and 2.8 Bev, 16: 16983 (NP-11592(Vol.I)(p.419-25))
scattering, connection between meson (π^0) decay and Compton, 16: 17026

PSEUDOUREA, 2-(2-AMINOETHYL)-2-THIO-
protective effects against radiation injuries and nitrogen mustard in *E. coli*, 16: 16297
radioprotective effects combined with tryptamine, 16: 16296

PULMONARY ABSORPTION
of particles, tracer study using whole-body counting, 16: 16149

PULSE ANALYZERS
design and performance of time-to-height, for measuring gamma-proton coincidence, 16: 16547
design for gridded ionization chambers, 16: 16541
multiplier design and performance for, 16: 16548

PUMPS (LIQUID METAL)
testing to improve thrust prediction system, 16: 16479 (TIM-438)

PUPAE
radiation effects on fertility and survival of grain weevil, continuous and fractionated dose, 16: 16125
radiosensitivity of housefly, effects on development and emergence mechanism, 16: 16124

PUREX PROCESS
off-gas composition and handling, 16: 16464
strontium separation from wastes by carrier-precipitation process, 16: 17333 (HW-69534)

PYRENE
exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344

PYRIDINE
exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344

PYROCHLORES
analysis for niobium and tantalum by ion exchange, 16: 16312

PYROGALLOL
analytical use in niobium determination, 16: 16327
analytical use in tantalum determination, 16: 16328

PYRROLE
exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344

PYRROLIDONE, VINYL- POLYMERS
radioinduced graft polymerization on synthetic condensation polymers, 16: 16448(P)

Q

QUANTUM ELECTRODYNAMICS
analysis of the Kemmer scalar symmetrical model, 16: 17068 (JINR-D-860)
field equation modifications, 16: 16849
properties of a solution of the low equation for a local field theory model, 16: 17224

QUANTUM MECHANICS
measurements without wave packet reduction, 16: 16875
wave function single valuedness effects, 16: 17007

QUARTZ
meson (μ) collision losses in, 16: 16919

8-QUINOLINOL
solvent properties for molybdenum and tin, 16: 16314

R

RABBITS
radiation effects on brain electrical activity in, 16: 16264
radiation effects on brain, comparison of sensitivity of various parts, 16: 16281
radiation effects on metabolic reactivity, role of nervous system in, 16: 16284
radiation effects on nervous system at low levels, 16: 16286
radiation effects on eyes, 16: 16175 (ASD-TR-61-415)

RADIATION
  biological effects, 16: 16228
  biological effects, indirect, reaction mechanisms, 16: 16230
  biological effects on behavioral changes in monkeys, 16: 16267
  biological effects on metabolic reactivity of chickens, rabbits, and rats, role of nervous system in, 16: 16284
  biological effects on eyes, 16: 16174 (ASD-TR-61-195)
  biological effects on brain, review, 16: 16182(T) (JPRS-13154 (p.15-20))
  biological effects on ultraslow potential fluctuations in cerebral cortex, 16: 16185(T) (JPRS-13154(p.38-55))
  conference on uses in entomology, Bombay, Dec. 1960, 16: 16108
  control of *Dysdercus* in tropical countries, 16: 16128
  depth dosage measurements in megavoltage therapy, 16: 16216
  doses at lunar surface, 16: 17329
  dosimetry in space, role of time factor in, 16: 16188
  effects on animal skin and tissues, response variations in millibeam, 16: 16190
  effects on bone metabolism of calcium, whole-bdoy exposure, 16: 16232
  effects on immune reactions, 16: 16178 (USNRDL-TR-553)
  effects on oral mucous membrane, 16: 16213
  energy distribution in mammalian cells, 16: 16229
  exposure time in glove boxes, motion picture analysis, 16: 16616
  genetic effects in man, 16: 16225
  mutagenic effects in insects, role in control of populations, 16: 16129
  neurological effects, conference at Vienna, June 5 to 9, 1961 on, 16: 16253
  neurological effects on membranes of nervous receptors, 16: 16254
  neurological effects on electrical characteristics of nerves, comparison with ultraviolet radiation, 16: 16256
  neurological effects on animal behavior, conditioning facilities and statistical analysis methods for studying, 16: 16265
  neurological effects on morphological changes in nervous system, 16: 16277
  neurological effects on vegetative nervous system, 16: 16280
  neurological effects on nervous system of rabbits at low levels, 16: 16286
  neurological effects on irritation processes in membranes, 16: 16287
  neurological effects, hypotheses on action mechanisms, 16: 16288
  research in entomology in France and associated countries, 16: 16132
  uses in crop protection, 16: 16110
  uses in insect control, 16: 16109
  uses, progress for civilian application program, 16: 17229(R) (BMI-1565(Del.))
RADIATION CHEMISTRY
  dilute aqueous solutions, diffusion kinetic equations of one-radical-one-solute model, 16: 16416
  organic deuterium and tritium isotope effects in, 16: 16086
RADIATION DAMAGE
  equipment and techniques used in studying low-temperature, 16: 16795
  measurement, nondestructive, 16: 16791
RADIATION DETECTION INSTRUMENTS
  design for cosmic-ray extensive air shower study, 16: 16514 (AFCRL-1092)
  design of ionization chamber, with a-c polarization, 16: 16563(P)
  for scanning man for internally-deposited gamma activity, advantages of dual instruments, 16: 16142
  performance for whole-body counting, 16: 16133
  performance for whole-body counting, 16: 16134
RADIATION DETECTION INSTRUMENTS (COLORIMETRIC)
  performance evaluation in Upshot-Knothole operation, 16: 16530 (WT-755)
  performance under conditions of high gamma radiation from nuclear detonation, 16: 16529 (WT-753)
RADIATION DETECTION INSTRUMENTS (ION CURRENT TYPE)
  design of scintillation, for gamma-neutron well logging, 16: 16571(P)
RADIATION DETECTION INSTRUMENTS (PULSE TYPE)
  correction factors for end-windowed Geiger-Mueller counters for absolute beta counting, 16: 16545
  design of hydrogen-gas filled G-M, for natural tritium measurements, 16: 16100
  performance employing crystal scintillation detector for whole-body counting, 16: 16158
  performance evaluation in Upshot-Knothole operation, 16: 16530 (WT-755)
  performance for monitoring bulk milk samples for iodine-131, 16: 16594 (AEEW-R-138)
  performance for whole-body counting, 16: 16140
  performance for whole-body counting, 16: 16145
  performance for whole-body counting, 16: 16146
  performance as whole-body counters, 16: 16155
  performance using liquid scintillation detectors for whole-body counting, 16: 16136
  performance, using plastic block scintillators, for whole-body counting, 16: 16137
  performance using single or multi-crystal array for whole-body counting, 16: 16138
  performance using scintillation detector for whole-body counting, 16: 16161
  performance using array of scintillation detectors for whole-body counting, 16: 16162
  performance using sodium iodide crystal detector for whole-body counting, 16: 16156
  photomultiplier tube performance in, 16: 16531(T) (UCRL-Trans-786(L))
  shielding for whole-body counting, 16: 16144
RADIATION DETECTORS
  calibration for whole-body counting, 16: 16134
  design and properties of fast-response total-radiation pyroelectric, 16: 16540
  design of portable gas-type, for wide range of radiation intensities, 16: 16568(P)
  performance for detecting delayed fission neutrons in reactor cooling circuits, 16: 16523 (CEA-2101)
  performance for whole-body counting, 16: 16133
RADIATION EFFECTS
  electron gas-molecular beam device for studying, 16: 16781 (WADD-TN-60-251)
  on biological materials, review, 16: 16180(T) (JPRS-13154(p.1-8))
  on fissionable materials, review, 16: 16663
  on solid bodies of high polymers, insulators, metals, and semiconductors, 16: 16625
  survey on reactor materials, 16: 16036
RADIATION INJURIES
  chemical protection, Japanese research, 16: 16298
  diagnosis by hematological values, 16: 16238
  of brain, histology and dosimetry, 16: 16251
  pathogenesis of late skin, 16: 16301
  protection against, effects of injections of isologous or homologous whole embryo cells, 16: 16289
  protection against, effects of 5-hydroxytryptamine, 16: 16299
  protection against, effects of oxytryptamine derivatives, 16: 16300
  protective effects of Syntocinon in mice, 16: 16199
  protective effects of tryptamines and tryptophans in mice, 16: 16200
  protective effects of egg and milk diet against, in dog, 16: 16294
  reaction mechanisms in yeast, 16: 16223
RADIATION MONITORING
  applications of alpha spectrometers, 16: 16552
  equipment and methods for direct continuous, 16: 16613
  use of plastic scintillators in, 16: 16614
RADIATION SICKNESS
  activation of dysentery in monkeys, 16: 16295
  carbon monoxide formation during, effects of triethylenetetracemine compounds on endogenic, 16: 16292
  effects on isoserological properties of blood, 16: 16290
  therapy by intraosseous transplantation of homologous bone marrow in rats, 16: 16291
RADIATION SOURCES
  design for insect control, 16: 16126
  gamma and neutron attenuation from Be–Po and cobalt-60, 16: 17161
  use in entomology in Pakistan, 16: 16130
  uses in engineering, 16: 16625
RADIATION TARGETS
  characteristics of filamentary and powdered, incorporated into nuclear emulsion, 16: 16967 (NP-11592(Vol.I)(p.307-25))

- design, 16: 17160
- film production by cathodic sputtering, chamber design for thin, 16: 16433

RADIO WAVES
- amplification, development of solid-state RASER, 16: 16515 (AFOSR-1794)
- amplification, effects of input signal field strength on enhancement and output of four-level RASER, 16: 16517 (AFOSR-1794(p.15-44))
- book: *Radiowave Absorption in the Ionosphere*, 16: 16916

RADIOACTIVE MATERIALS
- separation from water by electrodialysis, 16: 16603 (ERDL-1671-TR)
- shipping and handling regulations in Russia, 16: 16612(T) (JPRS-12823)

RADIOACTIVE WATERS
- monitoring equipment and methods, direct continuous, 16: 16613
- peroral administration of radon, effects on secretory function of stomach, 16: 16209

RADIOACTIVITY
- characteristics, decay laws, and particles or quanta, 16: 17011
- determination in water, 16: 16325
- physiological effects of large and small amounts in food, 16: 16617

RADIOAUTOGRAPHY
- methods for studying inclusion and segregation in metals, 16: 16052

RADIOBIOLOGY
- book: part of *Investigation of Early Reactions of the Organism to Radiation Effect*, 16: 16179(T) (JPRS-13154)
- radiation energy distribution in mammalian cells, 16: 16229
- reaction mechanisms in indirect effects of radiation on cells, 16: 16230
- review, 16: 16180(T) (JPRS-13154(p.1-8))

RADIOCHEMICAL PROCESSING PLANTS
- development for uranium oxide fuels, 16: 16456 (EURAEC-207)

RADIODIAGNOSIS
- dosimetry in, use of semiconductors, 16: 16556
- of brain tumors, 16: 16241
- of brain tumors, 16: 16244
- of brain tumors, 16: 16247
- of metabolic diseases, 16: 16162
- of thyroid diseases by uptake of iodine-131, 16: 16106
- of tumors by differential uptake of bismuth-206, 16: 16249
- of tumors by differential uptake of bismuth-206, 16: 16252

RADIOELECTRIC CELLS
- design for conversion to electric energy, 16: 16891(P)

RADIOGRAPHY
- geometric factors in thyroid scanning, 16: 16170
- method for studying metal deformation during tube making, use of radioactive inserts, 16: 16055
- of thick uranium specimens, 16: 16573 (WAL-TR-142.1/2)

RADIOISOTOPES
- conference on uses in entomology, Bombay, Dec. 1960, 16: 16108
- determination in solutions by copper-spark spectrography, 16: 16306 (PAN-250/XIII)
- production and uses of artificial, survey, 16: 16036
- research in entomology in France and associated countries, 16: 16132
- sorption, physico-chemical analysis of, 16: 16440
- use in entomology in Pakistan, 16: 16130
- use in insect control in Philippines, future, 16: 16131
- use of fixed sources in hinged-gate gas flowmeters, 16: 16073
- uses in engineering, 16: 16625
- uses in industry and physical sciences, 16: 16037
- uses, progress for civilian application program, 16: 17229(R) (BMI-1565(Del.))

RADIOLOGICAL WARFARE
- population injuries measured by hematological values, 16: 16238

RADIOMETERS
- design for beta preparations, 16: 16539

RADIOSENSITIVITY
- effects of anoxia in rats, 16: 16234
- housefly pupae, effects on development and emergence mechanism, 16: 16124
- of bacteria, effects of vitamin K, 16: 16220
- of cells in tissue culture, effects of phase in life cycle, 16: 16224
- of enzymes in nuclei of spleen and thymus, 16: 16219
- of *Escherichia coli*, effects of strain, 16: 16206
- of reticulo-endothelial function, 16: 16226
- of yeast, effects of strain, 16: 16223

RADIOSTERILIZATION
- grain and insect, for insect control, 16: 16126

RADIOTHERAPY
- applications of accelerated ion beams, 16: 16242
- effects on internal organs and nervous system, late, 16: 16207
- equipment, table for positioning patients, 16: 16488(P)
- esophagus, effects on cardiovascular system, 16: 16208
- exposure dose measurements in megavoltage, 16: 16216
- of brain lesions with collimated monoenergetic proton beams, 16: 16248
- of brain tumors, 16: 16241
- of brain tumors, by neutron capture therapy, 16: 16215
- of brain tumors, use of radioisotopes, 16: 16245
- of certain nervous and psychic diseases, 16: 16246
- of hemangioma in infants, late carcinogenic effects, 16: 16236
- of thyroid diseases in childhood, incidence of delayed tumors, 16: 16218
- of tumors of thorax, induction of bronchopneumonia, 16: 16227
- supervoltage facilities and techniques, review, 16: 16214
- teletherapy head design with shielded source, 16: 16163(P)
- use of cesium-137 for, 16: 16168

RADIUM
- determination in man, whole-body counting, 16: 16134
- determination in man after long-term retention, whole-body counting, 16: 16147
- determination in man, 16: 16171
- pathological effects in man, delayed, 16: 16171

RADIUM ISOTOPES
- determination in man, whole-body counting, 16: 16146

RADIUM ISOTOPES Ra-228
- determination in presence of radon-226, 16: 16323

RADON ISOTOPES
- monitoring in Antarctica between 60°N and 70°S in 1958, 16: 16042

RAIN WATER
- analysis for fall-out from fall 1961 USSR test series, 16: 16606 (HASL-121)
- analysis for tritium, geophysics, 16: 16077
- analysis for tritium, benzene liquid scintillator method for low-level, 16: 16097

RARE EARTH OXIDES
- thermal expansion coefficient determinations, accuracy and precision of x-ray diffraction for, 16: 16715(R) (CAL-PI-1273-M-10)

RARE EARTH SILICIDES
- crystal structure of erbium through lutetium, 16: 16378
- preparation and structure of holmium through lutetium and terbium, 16: 16377

RARE GASES
- polar molecule rotational states in crystalline, point dipole approximation, 16: 16330 (AD-264708)

RATE METERS
- performance evaluation in Upshot-Knothole operation, 16: 16530 (WT-755)
- performance of plastic scintillators as, 16: 16614

RATS
- blood volume determinations using chromium-51 and weight measurements, 16: 16103 (CEA-2112)
- fluorine activity distribution in tissues, tracer study, 16: 16167
- radiation-conditioned behavior, effects of habituation to laboratory and radiation procedures, 16: 16266
- radiation effects on brain activity at low doses, 16: 16268
- radiation effects on central nervous system, aerobic and anaerobic metabolic studies, 16: 16274
- radiation effects on neuron substructure of supra-optic and paraventricular nuclei, 16: 16278
- radiation effects on nervous system, 16: 16283
- radiation effects on metabolic reactivity, role of nervous system in, 16: 16284
- radiation effects on central nervous system, 16: 16282

REACTOR COMPONENTS
- development progress for civilian applications, 16: 17229(R) (BMI-1565(Del.))

REACTOR CONTROL ELEMENTS

properties and uses, survey, 16: 16036

REACTOR CONTROL RODS

position indicating apparatus design, 16: 17271(P)

REACTOR CONTROL SYSTEMS

design, 16: 17279(P)
design of reflector-valve, for boiling reactors, 16: 17305(P)
design of tripping circuit, 16: 17282(P)
design with pivoted control rods, 16: 17252(P)

REACTOR COOLANTS

energy absorption rates of organic, 16: 17236 (NAA-SR-6893)
purification of water-*d*, by ion exchange, 16: 16335(R) (DP-678)
radiation effects, survey, 16: 16036

REACTOR COOLING SYSTEMS

corrosion in gas, water, and liquid metal, survey, 16: 16036
heat transfer profiling along channel length, 16: 16511
monitoring for delayed fission neutrons due to fuel element canning burst, 16: 16523 (CEA-2101)

REACTOR ENGINEERING

training programs at Knolls Atomic Power Laboratory, 16: 17246

REACTOR FUEL ALLOYS

nitriding characteristics of fissium–uranium alloys, 16: 16464

REACTOR FUEL ALLOYS (LIQUID)

development for LAMPRE, 16: 17297(R) (LAMS-2681)
performance evaluation, review, 16: 16671

REACTOR FUEL ELEMENTS

book: *Nuclear Reactor Fuel Elements. Metallurgy and Fabrication*, 16: 16654
can end closure design, 16: 17257(P)
can end closure design, 16: 17258(P)
canning materials, properties, 16: 17287 (CNI-102)
chemical stability of metallic gas-cooled, 16: 17245
cladding, alloy with improved properties as, 16: 17276(P)
cladding ductility, Zircaloy, 16: 16723 (NMI-7211)
cladding technology, review, 16: 16661
cladding technology, review, 16: 16666
design and engineering aspects, review, 16: 16664
design and function, review, 16: 16656
design and performance in selected reactors, review, 16: 16669
design for compact pressurized water reactors, 16: 17283(P)
design for gas suspension cooled reactors, 16: 17278(P)
design of plate assembly for gas-cooled reactors, 16: 17272(P)
development progress for civilian applications, 16: 17229(R) (BMI-1565(Del.))
discharge from pebble-bed reactors, valve for, 16: 17280(P)
dissolution in acid, apparatus, 16: 16470(P)
economics aspects, review, 16: 16672
end cap closure, 16: 17265(P)
fabrication of subassemblies, review, 16: 16667
fabrication, review, 16: 16665
inspection and testing, review, 16: 16668
loading calculations, 16: 17243
processing, explosive device for separating casing members, 16: 16494(P)
processing of irradiated, review, 16: 16670
properties for heterogeneous reactors, survey, 16: 16036
radiation effects, 16: 17229(R) (BMI-1565(Del.))
radiation effects on defected Zircaloy-2-clad uranium(IV) oxide with fluoride impurities, 16: 16776 (CRFD-1067)
radiation effects on metallic, review, 16: 16663
reactions between cladding and core, review, 16: 16662
reactivity and void coefficients of uranium(IV) oxide rod lattices, 16: 17241(R) (UNC-5005)

REACTOR FUEL ELEMENTS (CERAMIC)

design of pellet with reduced tendency to crack or spall, 16: 17249(P)
preparation and properties, review, 16: 16660
radiation effects, review, 16: 16663

REACTOR FUEL ELEMENTS (DISPERSION)

design with uranium dioxide embedded in niobium-titanium alloy, 16: 17277(P)
radiation effects, review, 16: 16663

REACTOR FUEL PLATES

design for improved heat transfer, 16: 17262(P)

REACTOR FUEL RODS

extrusion of high-density uranium oxide, 16: 16697(R) (EURAEC-62)
extrusion of high-density uranium oxide, 16: 16698(R) (EURAEC-195)

REACTOR FUELS

development of coated-particle, 16: 17229(R) (BMI-1565(Del.))
development progress for civilian applications, 16: 17229(R) (BMI-1565(Del.))
processing irradiated, survey, 16: 16036

REACTOR FUELS (FUSED SALTS)

performance evaluation, review, 16: 16671

REACTOR MATERIALS

development progress for civilian applications, 16: 17229(R) (BMI-1565(Del.))
properties and uses, survey, 16: 16036

REACTOR MATRICES

heat transfer burnout, destruction testing by, 16: 17290(R) (DP-715)
reactivity and void coefficients of uranium(IV) oxide rod lattices, 16: 17241(R) (UNC-5005)
reactivity changes in, long term, 16: 17244
thermal utilization of homogeneous, 16: 17238 (NEI-168)

REACTOR MODERATORS

design of graphite block assembly for accommodating irradiation growth, 16: 17267(P)
purification of water-*d*, by ion exchange, 16: 16335(R) (DP-678)

REACTOR SAFETY

analysis of protective system failure probability, 16: 16595 (AHSB(S)R-35)
safeguards analysis of Defense Atomic Support Agency TRIGA Mark F, 16: 17309 (NP-11454)

REACTOR SAFETY EXPERIMENTS

research program for SPERT project, 16: 17235(R) (IDO-16750)
transient behavior of SPERT reactors, 16: 17235(R) (IDO-16750)

REACTOR SHIELDING

design for ducts of gas-cooled reactors, 16: 17248(P)

REACTOR SIMULATORS

design of inexpensive, 16: 17255(P)

REACTOR SLURRIES

preparation with improved wettability, 16: 17275(P)

REACTOR SOLUTIONS

performance evaluation, review, 16: 16671

REACTORS

control by suspension of cadmium granules in coolant, 16: 17256(P)
design and operation, review, 16: 16655
fuel discharging, device for emergency, 16: 17254(P)
kinetics, computer program for multigroup calculation of effective delayed-neutron fractions and prompt-neutron lifetimes, 16: 16632 (ANL-6511)
loading and unloading mechanism for use outside containment vessel, 16: 17274(P)
neutron fluctuations, analysis by use of random parameters, 16: 17231 (CEA-2115)
power fluctuations due to neutron noise, 16: 17230 (CEA-1855)
standpipe plug, self-engaging coupling device for, 16: 16487(P)

REFRACTORY COATINGS

deposition and development of corrosion resistant, high temperature, 16: 16703

REFRACTORY MATERIALS

corrosion by cesium at 1290 to 1830°F, 16: 16678 (TID-7626(Pt.I) (p.42-62))
corrosion by mercury at 600–1400°F, 16: 16677 (TID-7626(Pt.I)(p.23-34))
corrosion by sodium at 1500 to 2400°F, 16: 16677 (TID-7626(Pt.I) (p.23-34))
mechanical properties at 4000°F, development of equipment and methods for evaluation, 16: 16572 (ASD-TR-61-74)
properties evaluation for use as emitters in thermionic converters, 16: 16709(R) (AD-267010)
thermal conductivity coefficients, methods for measurement, 16: 16575(T) (DC-58-8-38)
wear, safety aspects of radiological studies, 16: 16066

RELATIVITY THEORY

invariant formulation of the gravitational wave field theory, 16: 17225
second postulate of special, experimental dubious significance,

16: 16816
REMOTE-CONTROL EQUIPMENT
design for opening radioactive tubular containers, 16: 16466(P)
design of coupling for tools in narrow channels, 16: 16496(P)
RESEARCH REACTORS
cooling tower performance tests for Japanese Research Reactor-2, 16: 17307 (JAERI-1022)
design of Canada-India, 16: 17306 (AECL-1443)
fuel element reactivity data for Pawling Lattice Test Rig, 16: 17241(R) (UNC-5005)
gamma radiation and neutron emission, measurement during simulated incident, 16: 16618
hazards summary for CANEL Test Reactor, 16: 16609 (PWAC-153)
neutron flux and spectra measurements in void tank irradiation chamber of TRIGA Mark F, 16: 17311 (SCR-480)
radiation dosimetry at shield surface of TRIGA Mark II, 16: 17310 (ORNL-TM-178)
safeguards analysis of Defense Atomic Support Agency TRIGA Mark F, 16: 17309 (NP-11454)
RESERPINE
protective effects against radiation injuries and nitrogen mustard in *E. coli*, 16: 16297
RESISTORS
testing and uses of precision decade, 16: 16527 (SCR-414)
RESPIRATORY TRACTS
bronchopneumonia induced by therapeutic irradiation of thorax, 16: 16227
RETICULO-ENDOTHELIAL SYSTEM
phagocytic activity, effects of radiation and zymosan, 16: 16226
RHENIUM FLUORIDES
physical properties, 16: 16464
RHENIUM OXYFLUORIDES
physical properties, 16: 16464
RHODIUM–TANTALUM ALLOYS
phase studies, 16: 16724(R) (NMI-9238)
RIBONUCLEIC ACID
radiation effects, gamma, heavy ion, and x, 16: 16189
ROCKET REACTORS
design, 16: 17325
ROCKETS
use during IGY, survey, 16: 16817
ROCKS
analysis for argon and helium for age estimations, 16: 16577 (TID-14861(Vols.I&II))
ROTARY SEALS
design and performance of gas-lubricated face, for blowers, 16: 16484
RUBBER
radio vulcanization, 16: 16413
RUBIDIUM
alpha reactions, yttrium-86 isomer production in, 16: 17115
emission spectra at high temperatures, pressure effects on, 16: 16819
magnetic spin susceptibility and thermal conductivity, 16: 16713 (AROD-431:44)
properties at 1000 to 2000°F, 16: 16685 (TID-7626(Pt.I)(p.111-14))
RUBIDIUM CHLORIDES
reactions with plutonium(III) chlorides and chlorine gas, formation of plutonium(IV) ions by, 16: 16367
RUBIDIUM HYDRIDES
excited state potential energy curves, 16: 16872
RUBIDIUM IONS
interactions with molybdenum, secondary ion emission, 16: 16881
RUBIDIUM ISOTOPES Rb-87
half life, 16: 16041
RUSSIAN REACTORS
characteristics of BR-5, 16: 17247
RUTHENIUM
determination in platinum by neutron activation, 16: 16326
RUTHENIUM CHLORIDE COMPLEXES
chloro-, chlorohydroxy-, and hydroxy-, formation in aqueous solutions, 16: 16372
RUTHENIUM CHLORIDES
characteristics of trivalent, in aqueous solutions, 16: 16372
RUTHENIUM ISOTOPES Ru-100
energy levels, 16: 17081
excited state spectrum, first, 16: 17108
RUTHENIUM ISOTOPES Ru-102
energy levels, 16: 17081
excited state spectrum, first, 16: 17108
RUTHENIUM ISOTOPES Ru-103
determination in fission products by coincidence counting, 16: 16421
determination in water, sand, and biological materials, radiochemical method, 16: 16309 (PG-Report-308)
RUTHENIUM ISOTOPES Ru-104
excited state spectrum, first, 16: 17108
RUTHENIUM ISOTOPES Ru-106
determination in water, sand, and biological materials, radiochemical method, 16: 16309 (PG-Report-308)
sorption from aqueous solutions by manganese dioxide, 16: 16389
RUTHENIUM NITROSYL NITRATES
complexes with potassium, preparation and composition, 16: 16381
RUTILES
analysis for niobium and tantalum by ion exchange, 16: 16312

S

SACLAY REACTORS (EL-2)
fuel element design and performance, review, 16: 16669
SAFETY
activities at Goodyear Atomic Corp., Portsmouth, Ohio, 1961, 16: 16605 (GAT-R-281)
apparatus for serious radioactive accidents at Marcoule Center for Plutonium Production, 16: 16597 (CEA-2113)
regulations for shipping and handling radioactive materials in Russia, 16: 16612(T) (JPRS-12823)
SAFETY HAZARDS
in handling thorium, 16: 16593 (AEET/HP/SM-5)
review for radiological wear measurements on refractory materials, 16: 16066
SALTS
separation from water by electrodialysis, 16: 16603 (ERDL-1671-TR)
SAMARIUM
nuclear magnetic moments, spin-orbit coupling, and hyperfine fields, 16: 16831
separation from cadmium by coprecipitation with cadmium–cerium alloy, 16: 16464
specific heats at 200 to 900°K, 16: 16746
SAMARIUM ISOTOPES Sm-147
nuclear magnetic moments, 16: 16831
spin, 16: 17128
SAMARIUM ISOTOPES Sm-149
spin, 16: 17128
SAMARIUM ISOTOPES Sm-152
energy level decay, 16: 17097
energy levels, 16: 17081
excited state spectrum, first, 16: 17108
magnetic properties in europium ferrates, 16: 16832
SAMARIUM SULFATES
paramagnetic resonance of trivalent gadolinium ions in octohydrate, zero-field, 16: 16384
SAMARSKITES
analysis for niobium and tantalum by ion exchange, 16: 16312
SAMPLING
bottle-handling sealing methods for uranium concentrate, 16: 16474 (MCW-1455)
SANDS
analysis for ruthenium-103 and ruthenium-106, radiochemical method, 16: 16309 (PG-Report-308)
movement of sea, tracer techniques for, 16: 16586
transport in rivers, use of radioisotopes for measurement, 16: 16588
SATELLITES
argon-37 and tritium content in iron and lead of recovered, 16: 16080
instrumentation of Explorer VIII for ionosphere measurements, 16: 17316 (NASA-TN-D-414)
use during IGY, survey, 16: 16817
SAVANNAH RIVER COMPONENTS TEST REACTOR

criticality, preparations for initial approach, 16: 17290(R) (DP-715)
development, 16: 17299(R) (SRO-66)

SAVANNAH RIVER REACTOR MOCKUP
coolant, void reactivity coefficients, 16: 17234 (DP-641)

SCALERS
design and performance for recording nuclear data, 16: 16636
design of fast transistorized, for automatic operation, 16: 16534
pulse resolving circuit using tunnel diodes for reducing counting losses, 16: 16549

SCANDIUM
separation by solvent extraction using hydrogen 2-ethylhexyl phenacyl phosphonate, steric effects in, 16: 16366
separation from cadmium by coprecipitation with cadmium–cerium alloy, 16: 16464

SCANDIUM ISOTOPES Sc-44
beta decay, isospin conservation in, 16: 17084

SCANDIUM OXIDES
thermal expansion coefficients at 25 to 1000°C, 16: 16715(R) (CAL-PI-1273-M-10)

SCATTERING
amplitude absorptive analytic properties, 16: 17039
amplitude, analyticity of general unitarity term of three-momentum transfers, 16: 17019
amplitude properties of local non-causal current operators in S-matrix theories, 16: 17022
correspondence principle in indefinite-metric, 16: 17046
dispersion relations and stability conditions, 16: 17023
enhancement factors for final-state, 16: 17027
inelastic, interference between the amplitudes of, 16: 17055
redundant poles of S-matrix, 16: 17045
structure of S-matrix singularities, analyticity and unitarity, 16: 17021
theory of resonance, by atomic systems, 16: 16886
theory of resonance, 16: 17008

SCINTILLATION DETECTORS
calibration of single and multi-crystal, for whole-body counting, 16: 16138
description of glass, for continuous measurement of gas diffusion coefficients in liquids, 16: 16351
design and performance of high-pressure gas, 16: 16544
design for reduced light losses, 16: 16562(P)
development of low background liquid, for low specific activity tritiated water, 16: 16093
developments for low-level tritium counting, 16: 16094
liquid, efficiency for calcium-45 counting, 16: 16316
liquid, method for measuring low-level tritium using benzene, 16: 16097
performance for whole-body counting, 16: 16140
performance for whole-body counting, 16: 16145
performance for whole-body counting, 16: 16146
performance of liquid, for whole-body counting, 16: 16136
performance of plastic, for environs monitoring, 16: 16614
performance of single phototube liquid, for measurement of tritium in biological materials, 16: 16098
plastic block 3-unit, design and performance for whole-body counting, 16: 16137
plastic, performance as gamma detectors for whole-body counters, 16: 16143
sensitivity and origin of background in sodium iodide crystals, 16: 16135

SCRUBBERS
for removal of radioiodine, 16: 17332(R) (EURAEC-25)

SEA WATER
analysis for tritium in New Zealand, 1956 to 1960, 16: 16078

SEALS AND GLANDS
design criteria for plenum to reflector block seal in HTGR, 16: 17294 (GAMD-1375)
design of coupling device for plug in reactor standpipe, 16: 16487(P)

SEED
radiation effects on, application to crop protection, 16: 16110

SELENIUM ISOTOPES Se-76
energy levels, 16: 17081
excited state spectrum, first, 16: 17108

SELENIUM ISOTOPES Se-83
beta and gamma spectra and energy levels, 16: 17148

SEMICONDUCTOR DETECTORS
behavior of np, in presence of pp^+, 16: 16546
development for neutrons, 16: 16524(R) (EURAEC-185)
performance in radiodiagnosis, 16: 16556

SEMICONDUCTORS
radiation effects in engineering uses, 16: 16625
thermal diffusivity measurements, 16: 16708(R) (AD-266128)

SEPARATION PROCESSES
development for irradiated fuel elements, review, 16: 16670

SERINE
determination in protein hydrolyzates using carbon-14 or tritium labeled 1-fluoro-2,4-dinitrobenzene, 16: 16089

SERVOMECHANISMS
design of hydraulic, 16: 16493(P)

SEWAGE
monitoring equipment and methods, direct continuous, 16: 16613

SHEEP
radiation effects on Purkinje fibers of heart, 16: 16279

SHELLS
deformations and stability of shallow and deep spherical, 16: 16472 (AROD-2465.1)

SHIELDED CONTAINERS
design for storage of plugs and experimental devices from reactors, 16: 17331 (CEA-2084)

SHIELDING
bibliography on, annotated, 16: 17222 (NP-11466)
problems in cosmic radiation, 16: 16187

SHIELDING MATERIALS
preparation and properties of concrete with dispersed ores, 16: 17223(P)
radiation effects on hydrogenous, 16: 17221 (DC-52-5-41)

SHIPPING
regulations for radioactive materials in Russia, 16: 16612(T) (JPRS-12823)

SHIPPINGPORT PRESSURIZED WATER REACTOR
fuel element design and performance, review, 16: 16669

SHOCK TUBES
flow in magnetic annular, analysis of non-uniform, 16: 16803 (AFOSR-2194)

SHOCK WAVES
production and properties in variable-density stars, 16: 16906
propagation in collisionless plasma, 16: 16913
propagation in red giant stars, 16: 16914
properties in collisionless regions of stellar coronae, 16: 16912
role in thermonuclear research, 16: 17190
spectrum model for atmospheric, 16: 16580
structure of strong plane, solution of Boltzmann equations by two-fluid model, 16: 16852

SILICIDES
book: *Silicides and Their Use in Engineering*, 16: 16341(T) (FTD-TT-61-409)
thermoelectric properties, 16: 16708(R) (AD-266128)

SILICON
preparation processes for high-purity, radiochemical analysis, 16: 16075
radiation effects of thermal neutrons, radiation doping, 16: 16056

SILICON BRONZE
analysis for molybdenum and tin by solvent extraction with 8-quinolinol, spectrophotometric, 16: 16314

SILICON CARBIDE CRYSTALS
radiation effects, 16: 16524(R) (EURAEC-185)

SILICON CARBIDES
radiation effects on p-n junctions, 16: 16524(R) (EURAEC-185)

SILICON ISOTOPES Si-28
neutron reactions (n,α) at 14.6 Mev, 16: 17076

SILICON ISOTOPES Si-29
proton reactions (p,γ) at 1.3 to 1.5 Mev, resonances at 1375 and 1500 kev, 16: 17145

SILICON JUNCTIONS
characteristics of npp^+, as charged particle detector, 16: 16546

SILICON OXIDE–SODIUM OXIDE SYSTEMS
diffusion of calcium, potassium, and sodium ions in, in melts with calcium, lithium, and potassium oxides, 16: 16048

SILICON–VANADIUM SYSTEMS
- superconductivity, 16: 16830

SILICONE RUBBERS
- preparation of radiation-resistant, 16: 16303(P)
- preparation with improved radiation resistance, 16: 16444(P)

SILTS
- accumulation rates of marine, in Atlantic, Indian, and Pacific Oceans, thorium-230/thorium method for determination, 16: 16583
- transport in watercourses, tracer studies, 16: 16070

SILVER
- characteristics as radiation target, incorporated into nuclear emulsion, 16: 16967 (NP-11592(Vol.I)(p.307-25))
- diffusion and solubility in germanium at 700 to 930°C, tracer study, 16: 16057
- diffusion in moving grain boundaries in copper at 725°C, 16: 16046
- neutron self-shielding effect in activation, formula for measuring, 16: 16415
- separation from bismuth, cadmium, copper, lead, and zinc by anion exchange, 16: 16463

SILVER CRYSTALS
- diffusion of iron in, isotope effects, 16: 16047

SILVER ISOTOPES Ag-107
- abundance ratio to palladium-107, relation to solar-system age, 16: 16901
- decay schemes, 16: 17125

SILVER ISOTOPES Ag-109
- decay schemes, 16: 17125

SILVER ISOTOPES Ag-111
- decay schemes, 16: 17125

SKIN
- radiation effects on electrolyte permeability, 16: 16301
- radiation effects, delayed and indirect heavy ion and millibeam, 16: 16190
- radioinduced carcinoma after therapeutic exposure in infancy, 16: 16236

SKIN GRAFTING
- rejection by radiation chimeras, 16: 16178 (USNRDL-TR-553)

SLAGS
- analysis for niobium and tantalum by ion exchange, 16: 16312

SLUG CANS
- design for metal oxide slugs, 16: 17253(P)

SNOW
- analysis for tritium in New Zealand, 1956 to 1960, 16: 16078

SODIUM
- analysis for carbon, 16: 16690 (TID-7626(Pt.I)(p.146-9))
- analysis for oxygen, 16: 16689 (TID-7626(Pt.I)(p.143-5))
- analysis for oxygen, methods determination, 16: 16688 (TID-7626 (Pt.I)(p.141-2))
- corrosive effects on niobium-zirconium alloys at 1500 to 2400°F, 16: 16677 (TID-7626(Pt.I)(p.23-34))
- corrosive effects on loop construction materials at 1870°F, 16: 16678 (TID-7626(Pt.I)(p.42-62))
- emission spectra at high temperatures, pressure effects on, 16: 16819
- magnetic spin susceptibility and thermal conductivity, 16: 16713 (AROD-431:44)
- metabolism in man, tracer studies using sodium-22 and whole-body counter, 16: 16156
- radiation effects of neutrons on electric conductivity at low temperatures, 16: 16789
- self-diffusion in melts containing silica and sodium oxide, lithium oxide, calcium oxide, and potassium oxide, 16: 16048
- separation from cadmium by coprecipitation with cadmium–cerium alloy, 16: 16464

SODIUM (LIQUID)
- carburization of 304 stainless steel in, 16: 16682 (TID-7626(Pt.I) (p.92-100))
- corrosive effects on stainless steel at 1050 to 1600°F, 16: 16692 (TIM-490)
- heat transfer from boiling, 16: 16689 (TID-7626(Pt.I)(p.143-5))
- thermophysical properties, 16: 16741

SODIUM ARSENATES
- nuclear quadrupole resonance of arsenic-75 in, 16: 16360

SODIUM CHLORIDE CRYSTALS
- contamination rate from electron beams, reduction of, 16: 16841

SODIUM CHLORIDES
- activity coefficients in methanol–water mixture at 25°C, rule for calculation, 16: 16375
- reactions with plutonium(III) chlorides and chlorine gas, formation of plutonium(IV) ions by, 16: 16367
- solvent properties for beryllium, 16: 16373

SODIUM FLUORIDES
- solvent properties for plutonium tetrafluoride, 16: 16392

SODIUM FORMATES
- radiolysis, CO_2^- electron absorption spectra in gamma, 16: 16430
- radiolysis, spectra of CO_2^- radical in, 16: 16435

SODIUM IODIDE CRYSTALS
- performance as gamma detectors for whole-body counters, 16: 16143
- sensitivity and origin of background of, used as gamma detectors in whole-body counters, 16: 16135

SODIUM ISOTOPES Na-22
- determination in man, whole-body counting, 16: 16158
- determination in man, whole-body counting, 16: 16155

SODIUM ISOTOPES Na-23
- atmospheric production and fall-out of cosmic-ray-produced, 16: 16585
- triton reactions (t,p) at 5.89 to 5.96 Mev, energy levels from, 16: 17092

SODIUM ISOTOPES Na-24
- penetration of nerve cord in cockroach, 16: 16117

SODIUM ISOTOPES Na-25
- energy levels, 16: 17092

SODIUM NITRATES
- radiolysis, effects of intensity on, 16: 16425

SODIUM NITRITES
- protective effects against radiation injuries and nitrogen mustard in *E. coli*, 16: 16297

SODIUM OXALATES
- radiolysis, spectra of CO_2^- radical in, 16: 16435

SODIUM PHOSPHATES
- stability of phosphorus-32 labeled polymeta-, chromatographic study, 16: 16414

SODIUM REACTOR EXPERIMENT
- fuel element design and performance, review, 16: 16669

SOILS
- humidity measurement using thermal neutrons, design and calibration of apparatus for, 16: 16620
- radiation effects on availability of inorganic ions in, 16: 16176 (NP-11578)

SOLAR BATTERIES
- development of metal–semiconductor, 16: 16518 (ASD-TR-61-564)
- development of regenerative system using nitrosyl chloride, 16: 16480 (WADD-TR-60-821(Pt.II))

SOLAR FLARES
- cosmic ray composition, energy spectra, and time variations in fourteen, 16: 16186

SOLID PROPELLANTS
- radiation effects, summary, 16: 16778 (JPL-TR-32-234)

SOLIDS
- hardening of crystalline by gas bubbles, semicircular dislocation model for, 16: 16711 (AERE-M-1000)

SOLUTIONS
- analysis for radioisotopes by copper-spark spectrography, 16: 16306 (PAN-250/XIII)

SOLVENTS
- synthesis of halogenated fluorinated β-diketones for metal extraction, 16: 16401(P)

SPACE
- conference, 16: 17323

SPACE FLIGHT
- analysis of straight-line flight to Mars, 16: 17326
- propulsion by ion systems, 16: 17324
- propulsion by nuclear rocket, 16: 17325
- radiation dosimetry in, role of time factor in, 16: 16188

SPACE VEHICLES
- power plant development for, 16: 17327
- power plants, Joule cycle development for, 16: 17322
- propulsion by contained nuclear explosions, 16: 17328
- propulsion, electromagnetic pinch effect to accelerate ionized gases for,

16: 17320 (PPL-116)

SPECTRA
line intensities for seventy elements between 2000 and 9000 A, tables, 16: 16337 (NBS-MON-32(Pt.II))

SPECTRAL SHIFT CONTROL REACTOR
exponential measurements at elevated temperatures, 16: 17228 (BAW-1233)
physics experiments to demonstrate principle, 16: 17227 (BAW-1230 (Pt.I))

SPECTROMETERS
design and fabrication of nuclear magnetic resonance, 16: 16525 (NP-11497)
design of emission, for nitrogen determination in argon, 16: 16570(P)

SPECTROSCOPY
use of copper-spark method in analysis of radioactive solutions, 16: 16306 (PAN-250/XIII)

SPHALERITES
structure, 16: 16804 (AFOSR-2300)

SPHERES
neutron self-shielding effect in metallic, 16: 16415

SPINAL CORD
radiation effects on ventral root potentials in cats, 16: 16261
radiation effects on neuronal activity in cats, 16: 16262
radiation effects in white mice, 16: 16285

SPLEEN
antibody formation in, reaction mechanisms, 16: 16196

SPUTTERING
film production by cathodic, chamber design for thin, 16: 16433

STACK DISPOSAL
removal of radioiodine, 16: 17332(R) (EURAEC-25)

STAINLESS STEEL
analysis for tantalum, spectrophotometric, 16: 16313
brazing alloys for, corrosion in 565°F pressurized water, 16: 16675 (ORNL-2834)
carburization in sodium at 1000 to 1600°F, 16: 16682 (TID-7626 (Pt.I)(p.92-100))
coating with aluminum oxide by flame spraying, 16: 16641 (ARL-59)
corrosion by cesium at 1600 to 2500°F, 16: 16684 (TID-7626(Pt.I) (p.109-10))
corrosion by potassium–sodium alloys (liquid) at 1100 to 1500°F, 16: 16691 (TIM-435)
corrosion by sodium at 1050 to 1600°F, 16: 16692 (TIM-490)
corrosion of type 309SCb by nitric acid–hydrofluoric acid, ammonium fluoride, and ammonium fluoride–ammonium nitrate solutions, 16: 16464
development and properties for fuel element cladding, review, 16: 16661
dislocations in neutron irradiated and quenched, 16: 16790
dissolution, 16: 16464
inclusions, autoradiographic methods for studying, 16: 16052
joining to Zircaloy-2 by hard-soldering, 16: 16649(R) (EURAEC-194 (App.6))
microstructure of high-purity, of 18/8 type, 16: 16739
Mössbauer effect, effects of magnetic fields, 16: 16828
reactions with phosphorus and sulfur compounds in oils, up to 700°C, 16: 16054
welding, segregation of phosphorus and sulfur, 16: 16052

STAINLESS STEEL (AUSTENITIC)
corrosion of Carpenter-20 electrodes, in electrolytic dissolution of stainless steel– and zirconium–matrix fuels, 16: 16464

STARS
atmospheric turbulence in nearly stable, 16: 16904
dynamics of atmospheres and outer layers of intrinsic variable, 16: 16905
element abundances in high-velocity A, 16: 16896
evolution of Population II, 16: 16915
hydromagnetic properties, 16: 16638
mass loss by steady-state gas outflow, 16: 16907
mass loss by steady-state gas outflow, 16: 16908
photospheric convection and granulation, 16: 16909
shock-wave effects in variable-density, 16: 16906
shock waves in coronal collisionless region, 16: 16912
velocity fields in atmospheres, 16: 16910

STATISTICS
genetic data processing, 16: 16225

STEAM–WATER SYSTEMS
vaporization during flow, growing-bubble model for, 16: 16504(R) (TID-15429)

STEEL
adhesion to ethylene propylene rubber, 16: 16707(R) (AD-266319)
analysis for molybdenum and tin by solvent extraction with 8-quinolinol, spectrophotometric, 16: 16314
analysis for niobium, spectrophotometric, 16: 16315
fatigue under strain-controlled low-cycle conditions, 16: 16767
inclusions, autoradiographic methods for studying, 16: 16052
mechanical properties, effects of niobium content, 16: 16737
reactions with phosphorus and sulfur compounds in oils, up to 700°C, 16: 16054
structural properties and uses in reactors, survey, 16: 16036

STILBENE
exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344

STOMACH
secretory function, effects of peroral administration radon water on, 16: 16209

STRANGE PARTICLES
analysis of parities, 16: 17003 (NP-11592(Vol.II)(p.151-75))
interactions, classification summary, 16: 17002 (NP-11592(Vol.II) (p.141-9))
production by meson (π^-)-proton interaction at 16 and 24 Bev, 16: 16937 (NP-11592(Vol.I)(p.93-100))
production in meson (π^-)–proton interactions at 1.6 Bev/c, 16: 16978 (NP-11592(Vol.I)(p.375-83))
production of Y_1^* in meson (K^-)-proton interactions at 1.15 Bev/c, 16: 17042
resonances of isobaric, research status, 16: 17004 (NP-11592(Vol.II) (p.177-89))
resonances, theoretical models, 16: 17005 (NP-11592(Vol.II)(p.191-204))
theory, 16: 16947 (NP-11592(Vol.I)(p.163-8))

STRATOSPHERE
particle transport, tracer study, 16: 16584

STRESS ANALYSIS
deflections and stresses in perforated beams during bending, 16: 16477 (TIM-390)
of cylindrical pressure vessel with ellipsoidal head and short head-to-cylinder transition section, 16: 16478 (TIM-408)

STRONTIUM
deuteron reactions, yttrium-86 isomer production in, 16: 17115
release from strontium carbonate, effects of air and temperature, 16: 16336 (HW-69692)
separation from cadmium by coprecipitation with cadmium–cerium alloy, 16: 16464
separation from Purex wastes by carrier-precipitation process, 16: 17333 (HW-69534)
separation from solutions by carrier precipitation, 16: 16467(P)

STRONTIUM CARBONATES
release of strontium, effects of air and temperature, 16: 16336 (HW-69692)

STRONTIUM COMPLEXES
with phosphates, ion-exchange study of nature and stability, 16: 16399

STRONTIUM FLUORIDE CRYSTALS
absorption bands of colored and uncolored, models for, 16: 16857
cohesive and surface energies of fluorite structure, 16: 16386
coloring under imposed voltage, moving striations in additive, 16: 16860

STRONTIUM ISOTOPES Sr-85
determination in man, whole-body counting, 16: 16159
determination in man, whole-body counting, 16: 16161
determination in man, whole-body counting, 16: 16162

STRONTIUM ISOTOPES Sr-89
effects of injected, on blood picture, 16: 16237

STRONTIUM ISOTOPES Sr-90
effects of injected, on blood picture, 16: 16237
effects on seasonal fluctuations of intestinal flora sensitivity to antibiotics, 16: 16210
monitoring in Antarctica between 60°N and 70°S in 1958, 16: 16042
properties as heat sources, 16: 16464
separation from fission products, 16: 17336

STRONTIUM SULFATES
reactions with clays, solid state formation of feldspars in, 16: 16578
STRUCTURAL COLUMNS
deflections and stresses in perforated beams during bending, 16: 16477 (TIM-390)
STRUCTURES
blast effects from Project Gnome, pre-shot and post-shot surveys, 16: 16608 (PNE-127P)
blast effects on concrete cubical, 16: 16574 (WT-721)
blast loading on horizontal cylindrical shapes, 16: 16481 (WT-722)
blast loading, pressure measurements in Upshot-Knothole Operation, 16: 16482 (WT-740)
STYRENE POLYMERS
analysis for carbon-14 by liquid scintillation, 16: 16091
use and properties as membrane filter, 16: 16490(P)
SULFEX PROCESS
cost comparison with mechanical shear-leach for processing clad uranium oxide fuels, 16: 16457 (ORNL-3227)
SULFIDES
synthesis of organic unsaturated, 16: 16451(P)
thermoelectric properties, 16: 16708(R) (AD-266128)
SULFONATES
analytical use of diammonium-5,5′-indigo di-, for determination of zirconium, 16: 16322
SULFOSALICYLATE COMPLEXES
properties in ion exchange separation of metal cations, 16: 16329
SULFUR
adsorption onto hydrogen-supersaturated iron surfaces, tracer study, 16: 16051
reactions with metals, up to 700°C, 16: 16054
segregation in welds in stainless steel, 16: 16052
SULFUR COMPOUNDS
reactions with metals, up to 700°C, 16: 16054
SULFUR ISOTOPES S-32
energy levels, 16: 17090
SULFUR ISOTOPES S-35
atmospheric distributions and fall-out of cosmic-ray-produced, 16: 16587
atmospheric distribution and fall-out of cosmic-ray-produced, 16: 16589
atmospheric production and fall-out of cosmic-ray-produced, 16: 16585
determination in organic compounds by liquid scintillation, 16: 16091
SULFURIC ACID
oxidation-reduction potential of uranium(IV)–uranyl system in, effects of temperature on, 16: 16364
solvent properties and spectral effects on protactinium(V), 16: 16365
SULTONES
radiolysis of unsaturated, yields from, 16: 16437
SUN
motion of lower atmosphere, near activity transients, 16: 16911
photospheric convection and granulation, 16: 16909
thermodynamic equilibrium of calcium, magnesium, and oxygen in chromosphere, 16: 16898
velocity fields in atmosphere of, detection and measurement, 16: 16897
SUPERCONDUCTIVITY
Hamiltonian role in field theory approximation methods, 16: 16850
SUPERCONDUCTORS
development, 16: 16710(R) (AD-267028)
flux quantization in, 16: 16877
SUPERHEATERS (NUCLEAR)
design for boiling water reactor, 16: 17304(P)
SURFACE WATERS
analysis for carbon dioxide and residual gases in geothermal, in New Zealand, mass spectrometric, 16: 16581
analysis for carbon-13/12 ratio in geothermal, in New Zealand, 16: 16582
analysis for ruthenium-103 and ruthenium-106, radiochemical method, 16: 16309 (PG-Report-308)
analysis for tritium, geophysics, 16: 16077
analysis for tritium in New Zealand, 1956 to 1960, 16: 16078
phosphorus movement through ecosystem of cold-water West Branch of Sturgeon River, tracer studies, 16: 16172(R) (TID-15385)
sand transport in, use of radioisotopes for measurement, 16: 16588
seepage, tritium tracer measurements, 16: 16082
transport of solids in, tracer studies, 16: 16070
SWIMMING POOL REACTORS
argon-41 content and escape velocity, 16: 17312
SWITCHES
design and operation of stable electronic integrator, for use with monopolar signal, 16: 17169
design of fast-acting high-current, 16: 17219(P)
SYNCHROCYCLOTRONS
proton beam depolarization during initial acceleration, resonance effects on, 16: 17167
SYNCHROTRONS
electron oscillations, measurement by rapid photography, 16: 17171
magnetic field errors at low field, 16: 17164
radiation control, safety, and shielding at Laboratori Nazionali de Frascati, 16: 17163
SYSTEMS FOR NUCLEAR AUXILIARY POWER
coolant corrosive effects, 16: 16681 (TID-7626(Pt.I)(p.87-91))

T

TANTALITES
analysis for niobium and tantalum by ion exchange, 16: 16312
TANTALUM
corrosion by cerium-cobalt-plutonium alloys at 750 to 900°C, 16: 17297(R) (LAMS-2681)
corrosion by cesium at 1600 to 2500°F, 16: 16684 (TID-7626(Pt.I) (p.109-10))
determination in concentrates, minerals, and ores by ion exchange, 16: 16312
determination in iron, niobium, and steel, spectrophotometric, 16: 16313
determination, pyrogallol complexometric, 16: 16328
diffusion and solubility in germanium at 700 to 930°C, tracer study, 16: 16057
reactions with neon-20 and nitrogen-14 ions, nitrogen-17 production, 16: 17153
thermal conductivity at 0.2 to 1.2°K, 16: 16874
TANTALUM BORIDES
erosion by gases at 3000°K, 16: 16726(R) (NP-11311)
TANTALUM CARBIDES
erosion by gases at 3000°K, 16: 16726(R) (NP-11311)
TANTALUM ISOTOPES Ta-181
neutron inelastic scattering at 2.95 Mev, gamma spectrum, 16: 17140
TANTALUM OXIDES
phases, metallographic study, 16: 16745
TANTALUM–TUNGSTEN–ZIRCONIUM ALLOYS
phase studies, 16: 16724(R) (NMI-9238)
TECHNETIUM ISOTOPES Tc-99
separation from pitchblende and activity, 16: 16369
TELLURIUM
diffusion and solubility in germanium at 700 to 930°C, tracer study, 16: 16057
separation from astatine, chromotographic, 16: 16397
TELLURIUM ISOTOPES Te-122
energy levels, 16: 17081
excited state spectrum, first, 16: 17108
TELLURIUM ISOTOPES Te-126
energy levels, 16: 17081
TERBIUM
crystal spin-screw structure, magnetic field effects, 16: 16829
solubility in cadmium(liquid), 16: 16464
TERBIUM RUTHENATES
magnetic susceptibility at 2 to 1300°K, 16: 16837
TEREPHTHALIC ACID, ETHYLENE POLYMER ESTERS
radioinduced graft polymerization of vinyl amides on, 16: 16448(P)
TERPHENYL
phosphorescence in liquid scintillation counting, 16: 16095
THALLIUM ISOTOPES Tl-200
electron (K) capture branching ratio to positron emission, 16: 17113
THALLIUM ISOTOPES Tl-203
energy levels, 16: 17075
THALLIUM ISOTOPES Tl-207
beta decay, pseudoscalar interaction in, 16: 17080
THALLIUM ISOTOPES Tl-208

energy levels from bismuth-212 decay, 16: 17082
THERMAL CONDUCTIVITY
measurement in ceramics up to 1500°C, 16: 16575(T) (DC-58-8-38)
THERMAL INSULATION
design for reactor pressure vessel nozzles, 16: 17260(P)
THERMAL NEUTRONS
dosimetry at surfaces of biological shield of TRIGA Mark II Research Reactor, 16: 17310 (ORNL-TM-178)
flux axial distribution at various moderator levels in NRX reactor, 16: 17232 (CRC-1058)
use for soil humidity measurements, 16: 16620
THERMIONIC CELLS
bibliography, 16: 17315 (JPLAI-LS-392)
bibliography on direct energy conversion by, 16: 16808 (NP-11472)
design of plane-parallel cesium, 16: 16800(R) (AD-266440)
development, 16: 16710(R) (AD-267028)
development, 16: 16810(R) (PPL-TR-61-22)
development, 16: 16848
emitters in, use of refractory metals for, 16: 16709(R) (AD-267010)
operation, plasma and sheath phenomena in, 16: 16800(R) (AD-266440)
work functions in cesium, collector-emitter differences, 16: 16842
THERMODYNAMICS
irreversible processes, kinetic equations for, 16: 16820
THERMOELECTRIC CELLS
bibliography, 16: 17315 (JPLAI-LS-392)
design, economics and performance, 16: 16826
development, 16: 16710(R) (AD-267028)
development, 16: 16807(R) (GA-3093)
dynamic behavior, linear models for small-signal, 16: 16890
THERMOELECTRIC MATERIALS
development, 16: 16710(R) (AD-267028)
development for power conversion, 16: 16708(R) (AD-266128)
development for use in high-temperature conversion devices, 16: 16799(R) (AD-265462)
properties of mixed-valence, 16: 16734 (WCAP-1655)
thermochemical and thermodynamic properties, tables, 16: 16805 (ARF-3182-5)
THERMOMETERS
design and performance of acoustic, for high-temperature studies, 16: 16558
THERMOMETRY
acoustic, equipment and theory of, 16: 16558
THERMONUCLEAR EXPLOSIONS
fall-out distribution patterns, 16: 16596 (CDRP-182-101)
THERMONUCLEAR REACTIONS
production of energy by, with carbon as catalyst, 16: 17212(P)
shock waves in, converging, 16: 17190
THERMONUCLEAR REACTORS
description of converging shock wave, 16: 17190
design for direct conversion into electric power, 16: 17213(P)
design of Astron, 16: 17214(P)
THICKNESS GAGES
design of beta, for moving sheets and coatings, 16: 16565(P)
THIOLS
ionization potentials, effects of substitution, 16: 16406 (NP-11495)
radioinduced reactions with halogenated unsaturated organic compounds, 16: 16451(P)
THIOPHENE
exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344
THIOPHENES
carboxylic acid, analysis for tritium by liquid scintillation, 16: 16091
THORIUM
handling hazards from chemical and radiation toxicity, 16: 16593 (AEET/HP/SM-5)
preparation and properties, survey, 16: 16036
preparation and properties, review, 16: 16659
production, 16: 16464
separation from cadmium by coprecipitation with cadmium–cerium alloy, 16: 16464
separation from fission products, 16: 16441
THORIUM ALLOYS
preparation and properties, review, 16: 16659
THORIUM ISOTOPES
determination in man, whole-body counting, 16: 16146
THORIUM ISOTOPES Th-228
energy levels, 16: 16536
excited state spectrum, first, 16: 17108
THORIUM ISOTOPES Th-230
excited state spectrum, first, 16: 17108
THORIUM OXIDES
analysis for molybdenum and tin by solvent extraction with 8-quinolinol, spectrophotometric, 16: 16314
preparation of high-density compactible particles, 16: 16404(P)
THORIUM(IV) OXIDES
behavior, preparation, and structure, review, 16: 16660
THREONINE
determination in protein hydrolyzates using carbon-14 or tritium labeled 1-fluoro-2,4-dinitrobenzene, 16: 16089
THULIUM
crystal spin-screw structure, magnetic field effects, 16: 16829
magnetic structures at 4.2 to 293°K, 16: 16835
nuclear magnetic moments, spin-orbit coupling, and hyperfine fields, 16: 16831
solubility in cadmium(liquid), 16: 16464
THYMIDINE
metabolism of tritium labeled, single phototube liquid scintillation measurements, 16: 16098
THYMINE
radiolysis products in de-aerated aqueous solutions, 16: 16432
THYMUS
nucleoprotein structure, effects of whole-body irradiation, 16: 16233
radiosensitivity of enzymes in nuclei, 16: 16219
THYROID DISEASES
diagnosis, by 24-hour uptake of iodine-131, 16: 16106
metabolism of iodine, tracer studies, 16: 16161
THYROID GLAND
function study using I^{131}–Br^{82} mixture, 16: 16105
radiation treatment during childhood, subsequent tumor development, 16: 16218
scanning, geometric factors and physics, 16: 16170
toxicosis, method for diagnosis, 16: 16169
uptake of iodine-131, measurement, 16: 16106
TIME MEASUREMENT
instrumentation development and use in Project Gnome, 16: 16029 (PNE-115P)
TIN
determination in reactor materials by solvent extraction with 8-quinolinol, 16: 16314
TIN (LIQUID)
thermophysical properties, 16: 16741
TIN COMPOUNDS
Mössbauer effect in polymeric, 16: 16889
TIN ISOTOPES Sn-116
energy levels, 16: 17081
TIN ISOTOPES Sn-119
Mössbauer effect in normal and super conducting states, 16: 17138
TIN–ZIRCONIUM ALLOYS
analysis for molybdenum and tin by solvent extraction with 8-quinolinol, spectrophotometric, 16: 16314
bonding by gas-pressure method, 16: 16701
corrosion of Zircaloy-2 during long exposures, 16: 17291(R) (EURAEC-222)
dissolution, 16: 16464
ductility of Zircaloy cladding on swelling fuel, 16: 16723 (NMI-7211)
joining Zircaloy-2 to stainless steel by hard-soldering, 16: 16649(R) (EURAEC-194(App.6))
solvent properties for hydrogen at 400 to 520°C, 16: 16752
TISSUE CULTURES
radiosensitivity of cells, 16: 16224
TISSUES
analysis for cesium-134 in animal and plant, ashing procedures for, 16: 16165
radiation effects, response variation to heavy ion and millibeam,

16: 16190
  scintillation counting, solvent systems for, 16: 16166
TITANIUM
  abundance in high-velocity A stars, 16: 16896
  alloying effects on mechanical properties of aluminum-chromium-iron alloy, 16: 17276(P)
  corrosion by nitric acid, protective effects of chromium acid solutions, 16: 16464
  grain boundaries, effects of plastic deformation and recrystallization, 16: 16050
  separation from protactinium, chronotographic, 16: 16396
TITANIUM ALLOYS
  grain boundaries, effects of plastic deformation and recrystallization, 16: 16050
TITANIUM BORIDES
  deposition on refractory metals from liquid metals, 16: 16690 (TID-7626 (Pt.I)(p.146-9))
  erosion by gases at 3000°K, 16: 16726(R) (NP-11311)
TITANIUM CARBIDES
  elastic constants at 27°C, 16: 16726(R) (NP-11311)
  electric conductivity and Hall effect at 77 to 350°C, 16: 16726(R) (NP-11311)
  erosion by gases at 3000°K, 16: 16726(R) (NP-11311)
  reactions with hydrogen at 1800 to 2500°C, 16: 16726(R) (NP-11311)
  thermal conductivity at 400 to 1200°C, 16: 16733 (WADD-TR-60-581 (Pt.II))
TOLUENE
  phosphorescence in liquid scintillation counting, 16: 16095
  quenching properties for use in Geiger counters, 16: 16101
TOXINS
  response to nephrotoxic serums, effects of local abdominal irradiation in rabbits, 16: 16195
TRACER TECHNIQUES
  conference on tritium, 16: 16076
  development of high-dilution on-stream, 16: 16069
  use in study of crystal imperfections, 16: 16058
TRACER TECHNIQUES (AGRICULTURE)
  uses in plant protection, 16: 16110
TRACER TECHNIQUES (BIOLOGY)
  feeding behavior of phytophagous insects, 16: 16121
  methods for labeling ants in pineapple plantations, 16: 16111
  studies on agricultural insects, 16: 16109
  study of insect central nervous system, 16: 16117
  studying metabolism of insecticides in animals, 16: 16115
  technical problems in insect metabolism measurements, 16: 16120
  techniques for metabolism study of insecticides, 16: 16116
TRACER TECHNIQUES (CHEMICAL ENGINEERING)
  use for determining current efficiency of aluminum electrolytic cells, 16: 16072
TRACER TECHNIQUES (CHEMISTRY)
  description for analysis of high-purity silicon production processes, 16: 16075
TRACER TECHNIQUES (ENGINEERING)
  description of methods developed by Australian Atomic Energy Commission, 16: 16068
  development for lubrication and wear studies in large diesel engines, 16: 16062
  development for small-scale lubrication and wear studies, 16: 16063
  development for studies of additive-containing oils, 16: 16064
  development for wear studies of turbo-assembly suspension bearings, 16: 16065
  method for wear measurements in shearing dies and punches, 16: 16067
  safety aspects in wear studies of refractory linings, 16: 16066
  use for leak detection in hermetically sealed components, 16: 16071
TRACER TECHNIQUES (GEOLOGY)
  development for studying solids transport in watercourses, 16: 16070
  development for water flow measurements in oil fields, 16: 16074
  equipment for determining injectivity profiles of fluid injection wells, 16: 16590(P)
  evaluation of tritium, 16: 16077
  sand transport in rivers, 16: 16588
  sea sand movement, 16: 16586
  survey of tritium, 16: 16081
TRACER TECHNIQUES (MEDICINE)
  applications of whole-body counting, 16: 16162
  for localization of brain tumors, 16: 16231
  for measurement of bone marrow content, 16: 16107
  in diagnosis of brain tumors, 16: 16244
  in diagnosis of brain tumors, 16: 16247
  localization and diagnosis of tumors by uptake of bismuth-206, 16: 16249
  localization and diagnosis of tumors by uptake of bismuth-206, 16: 16252
  use for potassium-40 determinations in health and disease, 16: 16157
  use for studies of metabolism in various diseases, 16: 16160
  use of whole-body gamma spectrometry, 16: 16159
  use of whole-body counting, 16: 16161
  whole-body counting with simple detection systems, 16: 16155
TRAUMA
  radiation effects on healing, 16: 16198
TRIAZINES
  preparation of carbon-14 labeled 2-chloro-4-isopropylamino-6-diethylamino-5-, for counting, 16: 16412
TRIMESIC ACID
  exchange reactions with deuterium oxide, mechanism of platinum catalyzed, 16: 16344
TRITIUM
  concentration by reflux distillation of water, 16: 16084
  conference on uses in biological and physical sciences, 16: 16076
  content in atmospheric methane over Australia, Singapore, and United Kingdom, 1957 to 1959, 16: 16079
  content in chondritic meteorites and iron and lead material from recovered satellites, 16: 16080
  counting, design of Geiger-Müller counter for low-level, 16: 16099
  counting, developments in low-level scintillation, 16: 16094
  determination by liquid scintillation counting, developments in photomultiplier tubes for, 16: 16092
  determination in biological material by gas counting, zinc fusion method for, 16: 16102
  determination in free hydrogen and rain, benzene liquid scintillator method for low-level, 16: 16097
  determination in ground, rain, and surface water, geophysics, 16: 16077
  determination in labeled compounds, radio-column chromatographic, 16: 16096
  determination in New Zealand waters 1956 to 1960, 16: 16078
  determination in organic compounds by liquid scintillation, 16: 16091
  determination of low specific activity, development of liquid scintillator for, 16: 16093
  enrichment, method for electrolytic, 16: 16083
  exchange with hydrogen, thermodynamic isotope effects in, 16: 16088
  hyperon (Λ) binding energies in $({}_{\Lambda}\mathrm{T})$, 16: 17015
  isotope effects in radiolysis of organic compounds, 16: 16086
  measurement in biological materials with single phototube liquid scintillation counter, 16: 16098
  measurement of natural, in Geiger counters with internal quenching, 16: 16101
  measurements of natural, with hydrogen gas counting system, 16: 16100
  reactions with benzene, recoil, 16: 16442
  separation from tritium and tritium hydride by gas chromatography, 16: 16085
  survey of geological studies on, 16: 16081
  tracer application in determination of amino acids in protein hydrolyzates, 16: 16089
  tracer use for canal seepage measurements, 16: 16082
TRITONS
  angular distributions and energy in reactors, method for spectral measurements, 16: 16090
  interactions with neutrons at 14.6 Mev, elastic scattering, 16: 16520 (CEA-2002)
  reactions (t,α) and (t,p) at 5.74 to 5.96 Mev, 16: 17092
TRYPTOPHAN
  protective effects of 5-hydroxytryptophan against radiation in mice, 16: 16200
TUBES
  countercurrent flow of air and water in vertical, flooding velocities, 16: 16498 (AEEW-R-123)

- fabrication, metallic deformation during, 16: 16055
- fabrication of two-walled heat exchanger, 16: 16489(P)

TUMORS
- localization and diagnosis by differential uptake of bismuth-206, 16: 16249
- of thyroid, incidence in persons given radiation treatment to thyroid in childhood, 16: 16218
- radioinduced after therapeutic exposure in infancy, 16: 16236
- radioinduced in bone, 16: 16194
- radioinduced, reaction mechanisms, 16: 16228
- radiotherapy, review of supervoltage facilities and techniques, 16: 16214
- radiotherapy with cesium-137, 16: 16168
- uptake of boron compounds, 16: 16250

TUNGSTEN
- corrosion by cesium at 1600 to 2500°F, 16: 16684 (TID-7626(Pt.I) (p.109-10))
- corrosion by potassium at 1000 to 1800°F, 16: 16679 (TID-7626(Pt.I) (p.63-8))
- erosion by gases at 3000°K, 16: 16726(R) (NP-11311)
- neutron attenuation, 16: 17237 (NASA-TN-D-1184)
- preparation of high-purity, 16: 16705 (62-GC-206)

TUNGSTEN BORIDES
- thermal diffusion at 1300 to 1600°C, 16: 16733 (WADD-TR-60-581(Pt.II))

TUNGSTEN CRYSTALS
- deformation and mechanical properties of single, 16: 16705 (62-GC-206)
- elastic constants at 600 to 1800°C, 16: 16726(R) (NP-11311)

TUNGSTEN FLUORIDES
- physical properties, 16: 16464

TUNGSTEN ISOTOPES W-182
- energy levels, 16: 17081
- excited state spectrum, first, 16: 17108

TUNGSTEN ISOTOPES W-184
- energy levels, 16: 17081
- excited state spectrum, first, 16: 17108

TUNGSTEN ISOTOPES W-186
- neutron capture, rate measurements, 16: 17233 (CRRP-985-D)

TUNGSTEN OXYFLUORIDES
- physical properties, 16: 16464

TYROSINE
- determination in protein hydrolyzates using carbon-14 or tritium labeled 1-fluoro-2,4-dinitrobenzene, 16: 16089

U

ULTRAVIOLET RADIATION
- effects on species-specific morphological processes of Acetabularia, 16: 16239
- genetic effects in Drosophila, 16: 16201
- genetic effects in Drosophila, 16: 16204
- genetic effects in yeast, 16: 16222
- neurological effects on electrical characteristics of nerves, comparison with ionizing radiation, 16: 16256

UNDERGROUND EXPLOSIONS
- behavior, study by cinematography, 16: 16033(T) (UCRL-Trans-806(L))
- firing and timing for Project Gnome, 16: 16029 (PNE-115P)
- ground motion at Carlsbad, New Mexico from Project Gnome, 16: 16576 (PNE-129F)
- ground surface motion in Project Gnome, photography, 16: 16528 (VUP-2202)
- resonance neutron activation measurements in Project Gnome, 16: 17072 (PNE-113P)
- structure surveys before and after Project Gnome shot, 16: 16608 (PNE-127P)

UPSHOT-KNOTHOLE OPERATION
- blast effects on concrete structures, 16: 16574 (WT-721)
- blast loading on horizontal cylindrical shapes in, 16: 16481 (WT-722)
- pressure measurements on surfaces of nonresponsive structures in, 16: 16482 (WT-740)
- radiac equipment evaluation in, 16: 16530 (WT-755)
- tests of chemical dosimeters, 16: 16529 (WT-753)

URANIUM
- analysis for aluminum, volumetric, 16: 16307 (PG-Report-293)
- analysis for uranium-235 abundance in natural, 16: 16370
- creep properties of alpha, under constant and cycled temperatures, 16: 16770
- determination in bismuth–uranium alloys, controlled potential coulometric, 16: 16310
- fabrication of tubes, 16: 17290(R) (DP-715)
- fission gas re-solution during post-irradiation heat treatment, 16: 16755
- forging alpha, 16: 16700(T) (JPRS-13099)
- inclusions, autoradiographic methods for studying, 16: 16052
- occurrence of particles in fused uranium dioxide, 16: 16758
- oxidation, structure relation in formation of embryos by cathodic, 16: 16694
- preparation and properties, survey, 16: 16036
- preparation and properties, review, 16: 16657
- price reduction effects on fuel cycle costs, 16: 17298 (ORNL-TM-191)
- production, 16: 16464
- properties as reactor fuel, 16: 16764
- proton reactions at 680-Mev, product yields in, 16: 17133
- radiation and thermal cycling effects on creep properties, neutron, 16: 16796
- radiochemistry, 16: 16405 (NAS-NS-3050)
- radiography of thick specimens, 16: 16573 (WAL-TR-142.1/2)
- separation by solvent extraction with TBP, 16: 16464
- separation from cadmium by coprecipitation with cadmium–cerium alloy, 16: 16464
- separation from fission products, 16: 16441
- separation from fission products using alumina, 16: 16459
- separation from fission products, 16: 16471(P)
- separation from ores by acid leaching and amine extraction, 16: 16453(P)
- separation from ores by carbonate leaching, 16: 16454(P)
- solubility in zinc(liquid), 16: 16464
- vapor transport from uranium carbide in equilibrium with graphite, 16: 16721 (GAMD-1233)

URANIUM ALLOYS
- preparation and properties, review, 16: 16657

URANIUM CARBIDE–ZIRCONIUM CARBIDE SYSTEMS
- vaporization in thermoelectric cell cathodes, redeposition studies, 16: 16807(R) (GA-3093)

URANIUM CARBIDES
- dissociation pressure and heats of formation and vaporization, 16: 16352
- production, 16: 16464
- properties and uses in reactors, survey, 16: 16036
- uranium vapor transport from compacts with graphite, 16: 16721 (GAMD-1233)

URANIUM COMPLEXES
- with 3-acetyl-4-hydroxycoumarin, infrared spectrum and optical density, 16: 16368

URANIUM COMPOUNDS
- analysis for aluminum, boron, chromium, iron, and manganese, spectrographic, 16: 16304 (CNEN-96)

URANIUM CONCENTRATES
- sampling, bottling and sealing methods, 16: 16474 (MCW-1455)

URANIUM CRYSTALS
- radiation effects of thermal neutrons in alpha, dimensional changes, 16: 16788

URANIUM DEUTERIDES
- magnetic properties of the beta modification, 16: 16769

URANIUM(IV) FLUORIDES
- production, 16: 16403(P)

URANIUM(VI) FLUORIDES
- corrosive effects, method for measuring, 16: 16695
- production, 16: 16464
- reactions with hydrogen bromide in gaseous phase, 16: 16403(P)
- reactions with metallic fluorides, 16: 16334 (CEA-2110)

URANIUM HYDRIDES
- magnetic properties of the beta modification, 16: 16769

URANIUM(IV) IONS
- oxidation-reduction potential, effects of hydrochloric, perchloric, and sulfuric acids and temperature on, 16: 16364

URANIUM ISOTOPES
- abundance measurements, internal standard technique for thermal ioniza-

tion mass spectrometric, 16: 16317
geochemistry, survey, 16: 16577 (TID-14861(Vols.I&II))
separation methods, survey, 16: 16036
URANIUM ISOTOPES U-232
excited state spectrum, first, 16: 17108
URANIUM ISOTOPES U-233
alpha decay and thermal neutron fission, nuclear orientation effects, 16: 16061
URANIUM ISOTOPES U-234
alpha decay and thermal neutron fission, nuclear orientation effects, 16: 16061
excited state spectrum, first, 16: 17108
URANIUM ISOTOPES U-235
alpha decay and thermal neutron fission, nuclear orientation effects, 16: 16061
content in natural uranium, 16: 16370
neutron capture, rate measurements, 16: 17233 (CRRP-985-D)
price reduction effects on fuel cycle costs, 16: 17298 (ORNL-TM-191)
URANIUM ISOTOPES U-238
resonance neutron activation cross section, 16: 17072 (PNE-113P)
URANIUM LEACH RESIDUES
processing for actinium recovery, 16: 16460
URANIUM LEACH SOLUTIONS (ACID)
separation of uranium from, by solvent extraction with amine, 16: 16453(P)
URANIUM NITRIDES
preparation by hot pressing uranium and higher uranium nitrides, 16: 16452 (CEA-2103)
URANIUM ORES
carbonate leaching, catalyzed oxidation of uranium during, 16: 16454(P)
mines, radiation hazards in, 16: 16592 (AEET/HP/SM-4)
URANIUM(IV) OXIDE CRYSTALS
growth of single, 16: 17229(R) (BMI-1565(Del.))
preparation of single, by sublimation, 16: 16652
structure, effects of preparation methods on, 16: 16759
URANIUM(IV) OXIDE POWDERS
chemical and physical properties, 16: 16730(R) (ORO-543)
preparation of highly reactive, 16: 16644(R) (EURAEC-194(App.1))
sinterability, effects of particle-size distribution, 16: 16730(R) (ORO-543)
sintering of 1.6% enriched, 16: 16648(R) (EURAEC-194(App.5))
URANIUM OXIDES
nonstoichiometry, variation of partial molar entropy of oxygen, 16: 16738
sintering in continuous rotating furnace, 16: 16642(R) (EURAEC-3)
URANIUM OXIDES (STAINLESS STEEL CLAD)
processing, cost comparison of mechanical shear-leach with Sulfex, 16: 16457 (ORNL-3227)
URANIUM OXIDES (Zr ALLOY CLAD)
fabrication by mechanical compaction, 16: 17290(R) (DP-715)
radiation effects at high temperatures, 16: 16775 (CRFD-1044)
radiation effects on defected with fluoride impurities, 16: 16776 (CRFD-1067)
URANIUM(IV) OXIDES
behavior, preparation, and structure, review, 16: 16660
cladding with beryllium by gas-pressure bonding, 16: 17229(R) (BMI-1565(Del.))
diffusion of fission product gases in, 16: 16650(R) (EURAEC-194 (App.7))
diffusion of krypton-85 from irradiated, 16: 16756
electric conductivity of sintered, at room temperature to 600°C, 16: 16720 (EURAEC-213)
extrusion of high-density rods, 16: 16697(R) (EURAEC-62)
extrusion of high-density rods, 16: 16698(R) (EURAEC-195)
fabrication for irradiation tests, 16: 17296(R) (GEAP-3771-2)
molding, methods using compression cycles for dry, 16: 16645(R) (EURAEC-194(App.2))
processing of irradiated, 16: 16456 (EURAEC-207)
production, 16: 16464
properties and uses in reactors, survey, 16: 16036
radiation effects, 16: 16643(R) (EURAEC-194)
sintering in hydrogen, effects of moisture content of hydrogen, 16: 16647(R) (EURAEC-194(App.4))
sintering methods, 16: 16643(R) (EURAEC-194)
thermal conductivity, burn-out limits, 16: 17296(R) (GEAP-3771-2)
thermal shock of pellets, effects of diameter, 16: 16646(R) (EURAEC-194(App.3))
uranium particle occurrence in fused, 16: 16758
URANIUM(IV-VI) OXIDES
analysis for molybdenum and tin by solvent extraction with 8-quinolinol, spectrophotometric, 16: 16314
stoichiometry of UO$_{2.67}$, 16: 16370
URANIUM SILICIDES
electric conductivity and specific heat at 0 to 800°C, 16: 16733 (WADD-TR-60-581(Pt.II))
URANIUM TELLURATES
preparation and properties, 16: 16349
URANIUM–ZIRCONIUM ALLOYS
dissolution by hydrofluoric acid–hydrogen peroxide systems, 16: 16464
URANIUM–ZIRCONIUM ALLOYS (Zr CLAD)
bonding and fabrication by gas-pressure method, 16: 16701
URANYL CARBONATES
equilibrium constant in aqueous solution, 16: 16395
URANYL FLUORIDES
reactions with hydrofluoric acid and water, stability of hydrates and hydrofluorides from, 16: 16333 (CEA-2106)
URANYL IONS
oxidation-reduction potential in uranium(IV) ion system, effects of acids and temperature on, 16: 16364
sorption in carbonate solution, 16: 16395
URANYL NITRATE CRYSTALS
structure of dihydrate, 16: 16391
URANYL NITRATES
analysis for boron by absorptiometric techniques, 16: 16308 (PG-Report-296)
distribution coefficients in aqueous-ether solutions, 16: 16461
distribution coefficients in aqueous-diethyl ether systems, 16: 16462
UREA, THIO-
analysis for tritium by liquid scintillation, 16: 16091
URETHAN POLYMERS
radiation effects on stress-strain properties of elastomers, 16: 16779 (NARF-62-2T)
URINE
radiation effects on excretion of desoxycytidine in animals, 16: 16293

V

V PARTICLES
production in propane by mesons (π^-) at 6.1, 11.6, and 18.1 Bev, 16: 16938 (NP-11592(Vol.I)(p.101-10))
VACUUM GAGES
design and performance for measuring neutral gas density near magnetically confined plasma, 16: 17202
VACUUM SYSTEMS
pressure stage passages for firing electron or ion beams from, 16: 16813 (UTIA-78)
VACUUM VALVES
design of ultrahigh, 16: 16497(P)
VALINE
determination in protein hydrolyzates using carbon-14 or tritium labeled 1-fluoro-2,4-dinitrobenzene, 16: 16089
VALLECITOS BOILING WATER REACTOR
operation summary, 16: 17299(R) (SRO-66)
VAN ALLEN RADIATION BELTS
genetic effects on *Neurospora crassa* in lower, 16: 16191
VAN DE GRAAFF ACCELERATORS
use in radiation damage studies of metals, 16: 16795
VANADIUM ISOTOPES V-47
beta and gamma spectra and energy levels, 16: 17148
VANADIUM ISOTOPES V-51
energy levels, 16: 17075
VINYL COMPOUNDS
radioinduced graft polymerization on polyethylene, 16: 16449(P)
radioinduced polymerization in water for use as waxing dispersion, 16: 16400(P)

VIRIAL COEFFICIENTS
- applications of hypervirial theorems, 16: 16815
- calculation and consistency of fifth, for hard-sphere gas, 16: 16847

VIRUSES
- radiation effects, gamma, heavy ion, and x, 16: 16189

VISCOSITY
- measurements, theory of torsional oscillation method for, 16: 16343(T) (NASA-TT-F-88)

VITAMIN B_{12}
- absorption of cobalt-58 labeled, 16: 16158
- metabolism, tracer study, 16: 16159
- metabolism, tracer study, 16: 16161
- metabolism, tracer study, 16: 16162

VITAMIN K
- radiosensitivity effects in bacteria, 16: 16220

VITAMINS
- radiation effects on fat-soluble, 16: 16623

W

WASTE DISPOSAL
- liquid storage in abnormal-pressure underground reservoirs, 16: 16028
- methods and operations, review, 16: 16464
- storage of plugs and experimental devices from reactors, 16: 17331 (CEA-2084)
- survey of methods, 16: 17332(R) (EURAEC-25)

WASTE PROCESSING
- incineration, 16: 17332(R) (EURAEC-25)
- leaching, 16: 17332(R) (EURAEC-25)
- plant design at Japan Atomic Energy Research Institute, 16: 17334 (JAERI-1021)
- solidification with asphalt, 16: 17332(R) (EURAEC-25)

WASTE SOLUTIONS
- monitoring equipment and methods, direct continuous, 16: 16613

WATER
- analysis for radioactivity, 16: 16325
- analysis for Rhodamine B, spectrophotometric, 16: 16320
- boiling on horizontal plate, film, 16: 16508
- decontamination and demineralization by electrodialysis, 16: 16603 (ERDL-1671-TR)
- decontamination in nuclear war, 16: 16591 (AD-264822)
- electron absorption, 16: 16555
- electronic energy, 16: 16357
- flow in vertical tubes, flooding velocities for countercurrent annular, 16: 16498 (AEEW-R-123)
- gamma and neutron attenuation, calculation methods for, 16: 17161
- meson (μ) collision losses in, 16: 16919
- neutron attenuation, 16: 17237 (NASA-TN-D-1184)
- neutron reactions in, cross sections and spatial distributions, 16: 17059
- separation from water-d, physical and thermodynamic aspects, 16: 16628

WATER-*d*
- separation from water, physical and thermodynamic aspects, 16: 16628
- spectrum, hyperfine structure of rotational, 16: 16355

WATER-d_2
- exchange reactions with hetero- and polycyclic hydrocarbons, platinum catalyzed, 16: 16344
- iron(III) molar extinction coefficients, 16: 16387
- production methods, survey, 16: 16036
- purification in production reactors by ion exchange, 16: 16335(R) (DP-678)

WATER-*t*
- analysis for tritium, development of liquid scintillation detector for, 16: 16093
- use as tracer for water flow measurements in oil fields, 16: 16074

WATER-t_2
- use as tracer in measurements of lean body and total fat content of man, 16: 16151

WATER COOLED REACTORS
- cooling channels, burnout analysis, 16: 17226 (AEEW-R-117)
- corrosion problems survey, 16: 16036

WATER MODERATED REACTORS
- criticality calculations for mixtures of light and heavy water, computer code for, 16: 17286 (BAW-1230(Pt.II))
- design of air-cycle type with folded-metal-screen fuel elements, 16: 17288 (DC-52-4-37)
- reactivity control, 16: 17269(P)

WAXES
- preparation of improved waxing dispersions by irradiation, 16: 16400(P)

WEAR
- measurement in refractory materials by radiological means, safety aspects, 16: 16066
- measurement in shearing dies and punches, radiological, 16: 16067
- processes in small-scale uses, study by tracer methods, 16: 16063
- study in large diesel engines by tracer methods, 16: 16062
- study in turbo-assembly suspension bearings, by tracer methods, 16: 16065

WELL LOGGING
- equipment for determining injectivity profiles of fluid injection wells, 16: 16590(P)
- equipment for gamma-neutron, 16: 16571(P)
- methods for potassium-salts prospecting and potassium determination, 16: 16044

WOUNDS
- radiation effects on healing of infected, repeated, 16: 16211

X

X RADIATION
- biological effects on behavior development in fetuses, 16: 16272
- biological effects on Purkinje fibers of calf and sheep hearts, 16: 16279
- biological effects in *Escherichia coli*, chemical protection, 16: 16297
- biological effects on eyes of rabbits, 16: 16175 (ASD-TR-61-415)
- biological effects on electric properties of frog muscles, 16: 16181(T) (JPRS-13154(p.8-15))
- biological effects on electric properties of cerebral cortex, 16: 16183(T) (JPRS-13154(p.21-34))
- biological effects on bacteria, DNA, eggs, enzymes, mammalian cells, virus, and yeast, 16: 16189
- detection and measurement, performance of semiconductor detectors in radiodiagnosis, 16: 16556
- effect on dual-nucleated transplants of Acetabularia, 16: 16240
- effects of fetal exposure on subsequent behavior and learning ability, 16: 16221
- effects of local abdominal exposure on response to nephrotoxic serum, 16: 16195
- effects on electroencephotographs of brain tumors, 16: 16260
- effects on electrolyte permeability in skin, local high-level exposure, 16: 16301
- effects on healing of infected wounds in rabbits, repeated, 16: 16211
- effects on mammalian embryos, low-level exposure, 16: 16212
- effects on urinary excretion of desoxycytidine in animals, 16: 16293
- effects on wound healing, local exposure, 16: 16198
- genetic effects in Drosophila, 16: 16202
- neurological effects on frog nerve-muscle preparation response to electric stimuli, 16: 16257
- neurological effects on presynaptic failure of neuromuscular transmission, 16: 16258
- neurological effects on electroretinal response of frog eyes, 16: 16259
- neurological effects on ventral root potentials in spinal cords of cats, 16: 16261
- neurological effects on neuronal activity in spinal cord of cats, 16: 16262
- neurological effects on brain electrical activity in cats and rabbits, 16: 16264
- neurological effects on brain activity in cats and rats, 16: 16268
- neurological effects on developing embryos, 16: 16270
- neurological effects of pre-natal irradiation on behavior of rats, 16: 16271
- neurological effects on 3-(2-aminoethyl)-5-indolo content of brain in rats, 16: 16273
- neurological effects on neurosecretory activity of neurons of supra-optic and paraventricular nuclei in rats, 16: 16278
- neurological effects on central nervous system in rats, 16: 16282
- neurological effects, comparison of response variability and degree of higher activity of nervous system, 16: 16283
- neurological effects of spinal-cord irradiation in white mice, 16: 16285

neurological effects on brains of pigeons and rabbits, comparison of sensitivity of various parts, 16: 16281
pathological effects on liver cytoplasm, whole-body exposure, 16: 16235

X-RAY-DIFFRACTION ANALYSIS
cell design for, beryllium, 16: 16560

X-RAY SOURCES
dose distribution for food irradiation facility, homogeneous, 16: 16624

XENON
corresponding states theory, 16: 16374
electron transfer collisions near adiabatic conditions with bromine ions, carbon atoms and ions, hydrogen ions, lithium ions, and oxygen atoms, 16: 16868
separation from krypton, 16: 16455 (CEA-2111)

XENON ISOTOPES Xe-126
energy levels, 16: 17081

XENON ISOTOPES Xe-128
energy levels, 16: 17081

Y

YEASTS
mutations, extrachromosomal induced by ultraviolet radiation, 16: 16222
radiation effects, gamma, heavy ion, and x, 16: 16189
radiosensitivity, effects of strain, 16: 16223

YTTERBIUM
nuclear magnetic moments, spin-orbit coupling, and hyperfine fields, 16: 16831
solubility in cadmium(liquid), 16: 16464

YTTERBIUM ISOTOPES Yb-170
energy level at 84 kev, structure splitting, 16: 17135

YTTERBIUM ISOTOPES Yb-173
nuclear magnetic moments, 16: 16831

YTTRIUM
separation by solvent extraction using hydrogen 2-ethylhexyl phenacyl phosphonate, steric effects in, 16: 16366
separation from cadmium by coprecipitation with cadmium–cerium alloy, 16: 16464
sorption from hydrochloric acid solutions by zirconium phosphates, 16: 16390

YTTRIUM ISOTOPES Y-86
production and properties of metastable, 16: 17115

YTTRIUM ISOTOPES Y-90
bremsstrahlung spectra from, internal, 16: 17107
determination in man and phantoms, whole-body counting, 16: 16140
use as beta source in irradiation of brain tumors, 16: 16245

YTTRIUM ISOTOPES Y-91
sorption from aqueous solutions by manganese dioxide, 16: 16389

YTTRIUM OXALATES
radioactivity measurements, production of uniform layers by means of centrifugal force for, 16: 16427

YTTRIUM OXIDES
thermal expansion coefficients at 25 to 1000°C, 16: 16715(R) (CAL-PI-1273-M-10)

YTTRIUM RUTHENATES
magnetic susceptibility at 2 to 1300°K, 16: 16837

YTTRIUM SILICIDES
preparation and structure, 16: 16377

YTTRIUM SULFATES
paramagnetic resonance of trivalent gadolinium ions in octohydrate, zero-field, 16: 16384

Z

ZEEP
neutron spectra in cylinder of hot heavy and light water mixtures, 16: 17233 (CRRP-985-D)

ZINC
determination in lithium chloride–potassium chloride eutectic, controlled potential coulometric, 16: 16310
radiation effects on availability in soils, 16: 16176 (NP-11578)
separation from bismuth, cadmium, copper, lead, and silver by anion exchange, 16: 16463

ZINC (LIQUID)
solvent properties for uranium, 16: 16464

ZINC ALLOYS
analysis for molybdenum and tin by solvent extraction with 8-quinolinol, 16: 16314

ZINC ISOTOPES Zn-64
alpha scattering at 42 Mev, magnetic analysis, 16: 16542

ZINC ISOTOPES Zn-65
sorption from aqueous solutions by manganese dioxide, 16: 16389

ZINC SULFIDE CRYSTALS
structure, 16: 16804 (AFOSR-2300)

ZIRCONIUM
analysis after neutron irradiation, systematic, 16: 16784
analysis for molybdenum and tin by solvent extraction with 8-quinolinol, spectrophotometric, 16: 16314
corrosion by cesium at 1600 to 2500°F, 16: 16684 (TID-7626(Pt.I) (p.109-10))
corrosion by high-temperature potassium, 16: 16680 (TID-7626(Pt.I) (p.69-86))
corrosion by water at 680°F, 16: 16674(R) (ARF-2198-24)
deformation and hydrogen embrittlement studies, 16: 17299(R) (SRO-66)
determination using diammonium-5,5′-indigo disulfonate, 16: 16322
dissolution, 16: 16464
preparation by electron-beam refining, 16: 16674(R) (ARF-2198-24)
separation from cadmium by coprecipitation with cadmium–cerium alloy, 16: 16464
separation from protactinium, chromotographic, 16: 16396
solvent properties for hydrogen at 400 to 520°C, 16: 16752
sorption from hydrochloric acid solutions by zirconium phosphates, 16: 16390
structural properties and uses in reactors, survey, 16: 16036

ZIRCONIUM ALLOYS
corrosion by water at 680°F, 16: 16674(R) (ARF-2198-24)
creep properties, alloying effects of metals, 16: 16772(P)
structural properties and uses in reactors, survey, 16: 16036

ZIRCONIUM BORIDES
erosion by gases at 3000°K, 16: 16726(R) (NP-11311)
vaporization near 2400°K, 16: 16726(R) (NP-11311)

ZIRCONIUM CARBIDES
elastic constants at 27°C, 16: 16726(R) (NP-11311)
electric and thermal conductivities at high temperatures, 16: 16733 (WADD-TR-60-581(Pt.II))
electric conductivity and Hall effect at 77 to 350°C, 16: 16726(R) (NP-11311)
erosion by gases at 3000°K, 16: 16726(R) (NP-11311)

ZIRCONIUM CLADDING
development and properties, review, 16: 16661

ZIRCONIUM ISOTOPES Zr-95
beta decay, isospin conservation in, 16: 17084
sorption from aqueous solutions by manganese dioxide, 16: 16389

ZIRCONIUM OXIDES
reactions with ammonia, phase formation during, 16: 16350
structure, effects of foreign oxides, 16: 16736(T) (UCRL-Trans-791(L))

ZIRCONIUM PHOSPHATES
ion exchange properties, 16: 16347
sorptive properties of high-temperature dessicated, for cesium, 16: 17337
sorptive properties for yttrium and zirconium, 16: 16390

ZIRCONS
age estimation studies, 16: 16577 (TID-14861(Vols.I&II))

REPORT NUMBER INDEX

All reports, translations, and patents abstracted in this issue are included in this index. Each item is listed by report number; this is followed by the abstract number and a brief notation regarding public availability. The index entries show, when known, which reports are on file in the depository libraries, which reports have been published in open-literature journals (journal citation given), and which reports can be purchased (source and price). Whenever a report is identified by more than one number, cross references from secondary to primary report numbers are cited.

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261903*	16-16922	OTS
263989*	16-16572	See ASD-TR-61-74
264135*	16-16810	See PPL-TR-61-22
264228*	16-16733	See WADD-TR-60-581(Pt.II)
264434*	16-16706	OTS
264708*	16-16330	OTS
264822*	16-16591	
264974*	16-16715	See CAL-PI-1273-M-10
265061*	16-16603	See ERDL-1671-TR
265279*	16-16174	See ASD-TR-61-195
265319*	16-16707	OTS
265376L*	16-16805	See ARF-3182-5
265462*	16-16799	OTS
266112*	16-17179	See RADC-TN-61-99
266128*	16-16708	OTS
266381*	16-16641	See ARL-59
266439*	16-17314	OTS
266440*	16-16800	OTS
266636*	16-17174	OTS
266981*	16-17320	See PPL-116
267010*	16-16709	OTS
267028*	16-16710	OTS
267044*	16-16175	See ASD-TR-61-415
267060*	16-16480	See WADD-TR-60-821(Pt.II))
268148*	16-17178	See ML-793
AE–	**(Swedish)**	
64	16-16513	Dep.(mc)
65	16-16773	Dep.(mc)
AEC-tr–		
4995	16-17242	Dep.(mc); $1.60(fs), $0.80(mf) JCL
5028	16-16735	Dep.(mc); $2.60(fs), $0.92(mf) JCL or OTS
5054	16-16410	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
5065	16-16411	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
AECL–	**(Canadian)**	
1443	16-17306	Dep.; $6.00(AECL)
1464	16-16775	See CRFD-1044
1471	16-17233	See CRRP-985-D
1472	16-16811	See PR-P-52
1473	16-16776	See CRFD-1067
1474	16-17238	See NEI-168
1481	16-17232	See CRC-1058
AEET-HP–	**(Indian)**	
SM-4	16-16592	Dep.(mc)
SM-5	16-16593	Dep.(mc)
AEEW-R–	**(British)**	
117	16-17226	Dep.
123	16-16498	Dep.; $0.42(BIS)
138	16-16594	Dep.; $0.42(BIS)
AERE-M–	**(British)**	
482	16-16751	J. Nuclear Materials 5: 193-9(1962)
931	16-16552	Phys. in Med. Biol. 6: 577-82(1962)
933	16-16759	J. Nuclear Materials 5: 262-3(1962)
1000	16-16711	Dep.; $0.25(BIS)
AERE-R–	**(British)**	
3519	16-16753	J. Nuclear Materials 5: 216-27(1962)
3572	16-16755	J. Nuclear Materials 5: 234-40(1962)
3672	16-16756	J. Nuclear Materials 5: 241-9(1962)
3980	16-16631	Dep.; $0.49(BIS)
AERE-T–	**(British)**	
M-126	16-17156	Dep.
AFCRL–	**(Non-AEC)**	
346	16-17178	See ML-793
1028	16-17175	OTS
1092	16-16514	
62-239	16-16801	OTS
AFOSR–	**(Misc.)**	
88*	16-16813	See UTIA-78
1794*	16-16515	
1934*	16-16802	
2194*	16-16803	
2300*	16-16804	
2361*	16-17180	See USCEC-83-212
AHSB(RP)-R–	**(British)**	
13	16-16218	Phys. in Med. Biol. 6: 583-98(1962)
AHSB(S)–	**(British)**	
R-35	16-16595	Dep.; $0.42(BIS)
ANL–		
6511	16-16632	Dep.; $1.50(OTS)
APAE–	**(Misc.)**	
115(Vol.I)	16-17284	Dep.(mc); $13.50(fs), $6.20(mf) OTS
115(Vol.II)	16-17285	Dep.(mc); $15.50(fs), $7.28(mf) OTS
ARF–	**(Misc.)**	
2198-24	16-16674	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2231-3*	16-16712	
3182-5*	16-16805	
ARL–	**(Non-AEC)**	
59	16-16641	$1.75(OTS)
132	16-16774	OTS
AROD–	**(Misc.)**	
431:44*	16-16713	
431:45*	16-17061	
2465:1*	16-16472	
2543:6*	16-17062	
ASD-TR–	**(Non-AEC)**	
61-74	16-16572	OTS
61-87	16-16714	OTS
61-195	16-16174	OTS
61-234	16-16302	OTS
61-415	16-16175	OTS
61-564	16-16518	OTS
BAW–	**(Misc.)**	
1230(Pt.I)	16-17227	Dep.; $2.75(OTS)
1230(Pt.II)	16-17286	Dep.; $2.25(OTS)
1233	16-17228	Dep.; $1.75(OTS)
BMI–	**(Misc.)**	
1565(Del.)	16-17229	Dep.; $2.00(OTS)
BNL–		
5546	16-16276	p.297-308 of "Effects of Ionizing Radiation on the Nervous System." Vienna, International Atomic Energy Agency, 1962
5641	16-16423	J. Inorg. & Nuclear Chem. 23: 159-60(1961)
5740	16-16838	J. Appl. Phys. 33: Suppl. to No. 3, 1336-8 (1962)
5762	16-16833	J. Appl. Phys. 33: Suppl. to No. 3, 1091-2 (1962)
5816	16-16310	Anal. Chem. 34: 594-6(1962)
BSD-TDR–	**(Non-AEC)**	
62-42	16-16806	
CAL-PI–	**(Non-AEC)**	
1273-M-10	16-16715	OTS
CDRP–	**(Non-AEC)**	
182-101	16-16596	
CEA–	**(French)**	
1855	16-17230	Dep.(mc)
1931	16-16519	Dep.(mc)
1934	16-16331	Dep.(mc)
2002	16-16520	Dep.(mc)
2010	16-16626	Dep.(mc)
2058	16-16510	Compt. rend. 253: 780-2(1961)
2084	16-17331	Dep.(mc)
2086	16-17063	Dep.(mc)
2088	16-16332	Dep.(mc)
2093	16-16521	Dep.(mc)
2094	16-16522	Dep.(mc)
2101	16-16523	Dep.(mc)
2103	16-16452	Dep.
2106	16-16333	Dep.(mc)

Report No.	Abstract No.	Availability
2110	16-16334	Dep.(mc)
2111	16-16455	Dep.(mc)
2112	16-16103	Dep.(mc)
2113	16-16597	Dep.(mc)
2115	16-17231	Dep.(mc)
CEA-Bib–	**(French)**	
28	16-16499	Dep.(mc)
CISE-R–	**(Italian)**	
51	16-17291	See EURAEC-222
CNEN–	**(Italian)**	
96	16-16304	Dep.(mc)
CNNW–	**(Canadian)**	
(RP-4)	16-16598	
CNI–	**(Italian)**	
102	16-17287	Dep.(mc)
CNLM–		
2166	16-16716	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3244	16-17064	Dep.(mc); $1.60(fs), $0.80(mf) OTS
CRC–	**(Canadian)**	
1058	16-17232	Dep.; $1.00(AECL)
CRFD–	**(Canadian)**	
1044	16-16775	Dep.; $1.00(AECL)
1067	16-16776	Dep.; $1.00(AECL)
CRRP–	**(Canadian)**	
985-D	16-17233	Dep.; $1.50(AECL)
CTSL–		
32	16-17065	Dep.(mc); $1.10(fs), $0.80(mf) OTS
CVNA–	**(Misc.)**	
90(Pt.B, Vol.I)	16-16599	Dep.(mc); $8.10(fs), $2.72(mf) OTS
90(Pt.B, Vol.II)	16-16600	Dep.(mc); $22.25(fs), $9.93(mf) OTS
90(Pt.B, Vol.III)	16-16601	Dep.(mc); $7.60(fs), $2.51(mf) OTS
90(Pt.B, Vol.IV)	16-16602	Dep.(mc); $8.10(fs), $2.75(mf) OTS
DC–	**(Misc.)**	
52-4-37	16-17288	Dep.(mc); $1.60(fs), $0.80(mf) OTS
52-5-41	16-17221	Dep.(mc); $1.60(fs), $0.80(mf) OTS
55-11-25	16-17289	Dep.(mc); $8.10(fs), $2.69(mf) OTS
58-4-71	16-16777	Dep.(mc); $8.10(fs), $2.84(mf) OTS
58-8-38	16-16575	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
58-11-114	16-16717	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
59-11-57	16-16500	Dep.(mc); $5.60(fs), $1.82(mf) OTS
59-12-83	16-16633	Dep.(mc); $2.60(fs), $1.07(mf) OTS
DF–	**(Misc.)**	
59-SL-314*	16-16718	
DP–		
641	16-17234	Dep.; $0.50(OTS)
678	16-16335	Dep.; $1.00(OTS)
715	16-17290	Dep.; $0.75(OTS)
DP-IS–	**(French)**	
SCI/61-343	16-16332	See CEA-2088
DSR–	**(Non-AEC)**	
7-7673	16-16503	See NP-11491
DUBNA REPORTS		**(Russian)**
See JINR (Russian)		
ERDL–	**(Non-AEC)**	
1671-TR	16-16603	OTS
EURAEC–		
3	16-16642	Dep.(mc); $5.60(fs), $1.88(mf) OTS
25	16-17332	Dep.(mc); $3.60(fs), $1.25(mf) OTS
62	16-16697	Dep.(mc); $2.60(fs), $0.86(mf) OTS
137	16-16719	Dep.(mc); $3.60(fs), $1.16(mf) OTS
147	16-16501	Dep.(mc); $2.60(fs), $0.95(mf) OTS
163	16-16305	Dep.(mc); $1.10(fs), $0.80(mf) OTS
170	16-17296	See GEAP-3771-2
185	16-16524	Dep.(mc); $1.60(fs), $0.80(mf) OTS
194	16-16643	Dep.(mc); $4.60(fs), $1.64(mf) OTS
195	16-16698	Dep.(mc); $1.60(fs), $0.80(mf) OTS
207	16-16456	Dep.(mc); $5.60(fs), $1.94(mf) OTS
213	16-16720	Dep.(mc); $3.60(fs), $1.19(mf) OTS
222	16-17291	Dep.(mc); $1.60(fs), $0.80(mf) OTS
262	16-16674	See ARF-2198-24
EXP-NRX–	**(Canadian)**	

Report No.	Abstract No.	Availability
5203	16-16775	See CRFD-1044
FTD-TT–	**(Non-AEC)**	
61-149	16-17182	OTS
61-409	16-16341	OTS
62-46	16-16342	OTS
62-435	16-16814	OTS
FXM–	**(Misc.)**	
208	16-16502	Dep.(mc); $1.60(fs), $0.80(mf) OTS
428	16-17292	Dep.(mc); $1.10(fs), $0.80(mf) OTS
GA–	**(Misc.)**	
1100(Suppl.3)	16-16604	Dep.(mc); $2.60(fs), $0.86(mf) OTS
2861	16-17293	Dep.(mc); $10.10(fs), $3.83(mf) OTS
3093*	16-16807	
GACD–	**(Non-AEC)**	
2165	16-16799	See AD-265462
GAMD–	**(Misc.)**	
1233	16-16721	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1375	16-17294	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2560	16-17295	Dep.(mc); $1.60(fs), $0.80(mf) OTS
GAT-R–		
281	16-16605	Dep.(mc); $5.60(fs), $1.94(mf) OTS
GEAP–	**(Misc.)**	
3771-2	16-17296	Dep.(mc); $4.60(fs), $1.67(mf) OTS
HASL–		
121	16-16606	Dep.; $0.50(OTS)
HW–		
69534	16-17333	Dep.(mc); $4.60(fs), $1.55(mf) OTS
69692	16-16336	Dep.(mc); $1.10(fs), $0.80(mf) OTS
71980	16-16473	Dep.; $0.50(OTS)
72379	16-16699	Dep.; $0.75(OTS)
IA–	**(Non-AEC)**	
698	16-17066	Dep.(mc)
IDO–		
16750	16-17235	Dep.; $0.75(OTS)
IS–		
382	16-16329	Talanta 9: 393-7(1962)
JAERI–	**(Japanese)**	
1021	16-17334	Dep.(mc)
1022	16-17307	Dep.(mc)
5008	16-17308	Dep.(mc)
JINR–	**(Russian)**	
D-810	16-16634	Dep.(mc)
D-857	16-17067	Dep.(mc)
D-860	16-17068	Dep.(mc)
D-922	16-17069	Dep.(mc)
E-859	16-16923	Dep.(mc)
JPL-TR–	**(Non-AEC)**	
32-234	16-16778	
JPLAI-LS–	**(Non-AEC)**	
392	16-17315	
JPRS–	**(Non-AEC)**	
12823	16-16612	OTS
12990	16-17183	OTS
13099	16-16700	OTS
13154	16-16179	OTS
13480	16-16032	OTS
JUL–	**(German)**	
33-PP	16-17176	Dep.(mc)
36-PP	16-17177	Dep.(mc)
LA–		
2611	16-16722	Dep.; $11.00(fs), $4.67(mf) OTS
LAMS–		
2581	16-17297	Dep.; $0.50(OTS)
MATT–		
58	16-17195	Phys. Fluids 5: 445-59(1962)
79	16-17198	Phys. Fluids 5: 487-91(1962)
MCW–		
1455	16-16474	Dep.; $0.50(OTS)
ML–	**(Misc.)**	
793*	16-17178	OTS
MR-N–	**(Non-AEC)**	

Report No.	Abstract No.	Availability
292	16-16780	See NARF-62-3T
293	16-16779	See NARF-62-2T
MRC–	**(Misc.)**	
260*	16-17174	See AD-266636
NAA-SR–		
6893	16-17236	Dep.; $0.75(OTS)
NARF–	**(Non-AEC)**	
62-2T	16-16779	
62-3T	16-16780	
NAS-NS–	**(Misc.)**	
3050	16-16405	Dep.; $3.50(OTS)
NASA-TN–	**(Misc.)**	
D-414*	16-17316	$1.00(OTS)
D-1184*	16-17237	$2.25(OTS)
NASA-TT–	**(Non-AEC)**	
F-88	16-16343	$3.50(OTS)
NBS-MON–	**(Misc.)**	
32(Pt.II)*	16-16337	$3.00(GPO)
NDA–	**(Misc.)**	
2093-7	16-17070	Dep.(mc); $2.60(fs), $1.10(mf) OTS
NDL-TR–	**(Non-AEC)**	
24	16-16607	
NEI–	**(Canadian)**	
168	16-17238	Dep.; $1.00(AECL)
NMI–	**(Misc.)**	
7211	16-16723	Dep.(mc); $3.60(fs), $1.40(mf) OTS
9238*	16-16724	
9517	16-16725	
NP–	**(AEC File No. for Non-AEC Reports)**	
11311	16-16726	
11454	16-17309	Dep.; $26.00(fs), $10.43(mf) OTS
11466	16-17222	OTS
11472	16-16808	Dep.(mc)
11476	16-17317	
11491	16-16503	
11493	16-17318	
11494	16-16475	
11495	16-16406	
11497	16-16525	
11509	16-16924	
11553	16-16727	
11564	16-17071	Dep.
11568	16-17319	
11578	16-16176	Dep.(mc)
11592(Vol.I)	16-16925	Dep.(mc)
11592(Vol.II)	16-16993	Dep.(mc)
NPCC-MWP–	**(British)**	
(G)/P157	16-16407	Dep.(mc)
(G)/P161	16-16408	Dep.(mc)
(G)P180	16-16338	Dep.(mc)
NRC–	**(Canadian)**	
6645	16-16386	Proc. Roy Soc. (London) A266: 344-58 (1962)
6766	16-16820	Can. J. Phys. 40: 463-519(1962)
NUCLEAR–		
52	16-16627	$3.00 A. V. Roe, Canada Ltd. Orenda Engines Div., Malton, Ont.
NYO–		
7877(Rev.1)	16-17058	Dep.; $0.50(OTS)
9457	16-16476	Dep.(mc); $6.60(fs), $2.03(mf) OTS
9750	16-16547	Nuclear Instr. & Methods 14: 311-14(1962)
10028	16-17026	Nuovo cimento (10) 23: 408-15(1962)
10030	16-17167	Rev. Sci. Instr. 33: 454-5(1962)
10056	16-16177	Dep.(mc); $4.60(fs), $1.49(mf) OTS
ONR–	**(Non-AEC)**	
4	16-16475	See NP-11494
ORNL–		
2834	16-16675	Dep.; $1.00(OTS)
3227	16-16457	Dep.; $1.50(OTS)
3250(Pt.I)	16-16728	Dep.; $0.50(OTS)
3250(Pt.II)	16-16729	Dep.; $0.75(OTS)

Report No.	Abstract No.	Availability
ORNL-TM–		
178	16-17310	Dep.(mc); $3.60(fs), $1.19(mf) OTS
191	16-17298	Dep.(mc); $6.60(fs), $2.27(mf) OTS
203	16-17239	Dep.(mc); $2.60(fs), $0.95(mf) OTS
ORO–		
543	16-16730	Dep.(mc); $1.60(fs), $0.80(mf) OTS
PAN–	**(Polish)**	
141	16-17071	See NP-11564
246/I-B	16-16731	Dep.(mc)
250/XIII	16-16306	Dep.
252/X	16-16104	Dep.
PATENTS	**(British)**	**3s. 6d. each, U. K. Patent Office**
890,934	16-16561	
893,399	16-16444	
893,400	16-16400	
893,505	16-16562	
893,609	16-16485	
893,647	16-16630	
893,668	16-17248	
893,701	16-16704	
893,737	16-16486	
893,742	16-17249	
893,783	16-17212	
893,851	16-16445	
893,858	16-17250	
893,881	16-17251	
893,907	16-16563	
893,962	16-17252	
893,970	16-17253	
893,978	16-17254	
893,989	16-16446	
894,002	16-17255	
894,009	16-16797	
894,156	16-16772	
894,187	16-17256	
894,193	16-17257	
894,194	16-17258	
894,204	16-16798	
894,228	16-17259	
894,288	16-16447	
894,395	16-16448	
894,407	16-17260	
894,418	16-17261	
894,441	16-16465	
894,453	16-17262	
894,471	16-16487	
894,494	16-17223	
894,500	16-16488	
894,593	16-17263	
894,613	16-16564	
894,633	16-17264	
894,641	16-17265	
894,668	16-17266	
894,717	16-17267	
894,753	16-16449	
894,756	16-16450	
894,807	16-16453	
894,848	16-17213	
894,883	16-16489	
894,898	16-17268	
894,902	16-17269	
894,903	16-17270	
894,914	16-17214	
894,929	16-16466	
894,970	16-17215	
894,972	16-17271	
895,016	16-17272	
895,030	16-17216	
895,082	16-16490	
895,222	16-16491	
896,245	16-16492	

Report No.	Abstract No.	Availability
895,295	16-17273	
895,353	16-16565	
895,356	16-17274	
895,676	16-16401	
PATENTS	**(U. S.)**	**$0.25 each, U. S. Patent Office**
3,031,388	16-17283	
3,031,390	16-17275	
3,031,391	16-16451	
3,031,392	16-17276	
3,031,399	16-17217	
3,031,519	16-16891	
3,031,573	16-16566	
3,031,575	16-16567	
3,031,577	16-16568	
3,031,596	16-17173	
3,031,846	16-16493	
3,032,356	16-16494	
3,032,428	16-16892	
3,032,490	16-17218	
3,032,492	16-17277	
3,032,497	16-16467	
3,032,531	16-16303	
3,032,653	16-16590	
3,032,654	16-16570	
3,032,657	16-16893	
3,032,658	16-16571	
3,032,659	16-16894	
3,032,661	16-16163	
3,033,229	16-16569	
3,033,549	16-16673	
3,033,645	16-16468	
3,033,753	16-16164	
3,033,771	16-16402	
3,033,773	16-17278	
3,033,774	16-17279	
3,034,088	16-16495	
3,034,689	16-17280	
3,034,814	16-16496	
3,034,854	16-16469	
3,034,868	16-16470	
3,034,889	16-16471	
3,034,977	16-17304	
3,034,978	16-17281	
3,035,894	16-16403	
3,035,895	16-16404	
3,035,993	16-17305	
3,035,996	16-17282	
3,036,172	16-17219	
3,036,811	16-16497	
3,036,881	16-16454	
3,036,963	16-17220	
PG-Report–	**(British)**	
293	16-16307	Dep.; $0.21(BIS)
296	16-16308	Dep.; $0.25(BIS)
308	16-16309	Dep.; $0.35(BIS)
314	16-16809	Dep.
PNE–		
113P	16-17072	Dep.; $1.00(OTS)
115P	16-16029	Dep.; $0.75(OTS)
127P	16-16608	Dep.; $0.75(OTS)
129F	16-16576	Dep.; $0.50(OTS)
PPAD–		
442D	16-17157	Dep.(mc); $2.60(fs), $0.80(mf) OTS
PPL–	**(Non-AEC)**	
116	16-17320	OTS
PPL-TR–	**(Non-AEC)**	
61-22	16-16810	OTS
PR-P–	**(Canadian)**	
52	16-16811	Dep.; $2.00(AECL)
PWAC–	**(Misc.)**	
153	16-16609	Dep.(mc); $12.50(fs), $5.39(mf) OTS
PWL–		
610-11-40A	16-16609	See PWAC-153
RAC–	**(Non-AEC)**	
458	16-16810	See PPL-TR-61-22
RADC-TN–	**(Non-AEC)**	
61-99	16-17179	OTS
RFA–	**(Swedish)**	
74	16-17074	See VDIT-50
RJ–	**(Non-AEC)**	
198	16-16475	See NP-11494
RTR–	**(Non-AEC)**	
79	16-16518	See ASD-TR-61-564
SB–	**(Non-AEC)**	
62-2	16-17222	See NP-11466
SC–	**(Misc.)**	
4667(RR)	16-16526	Dep.; $0.75(OTS)
SCR–		
414	16-16527	Dep.(mc); $1.60(fs), $0.80(mf) OTS
439	16-16812	Dep.; $1.50(OTS)
480	16-17311	Dep.; $0.50(OTS)
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